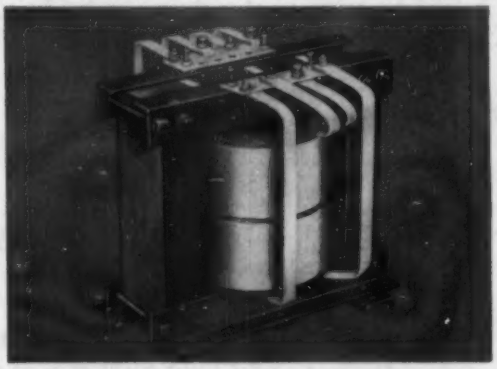
Power

NOVEMBER
1955·50¢

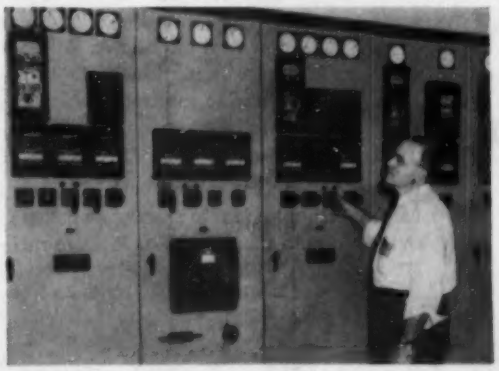
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Marmy's sure-fire cure for turbine ' jitters ' 146

Kill ion exchanger troubles. . . . 112



Aluminum for transformers? 95



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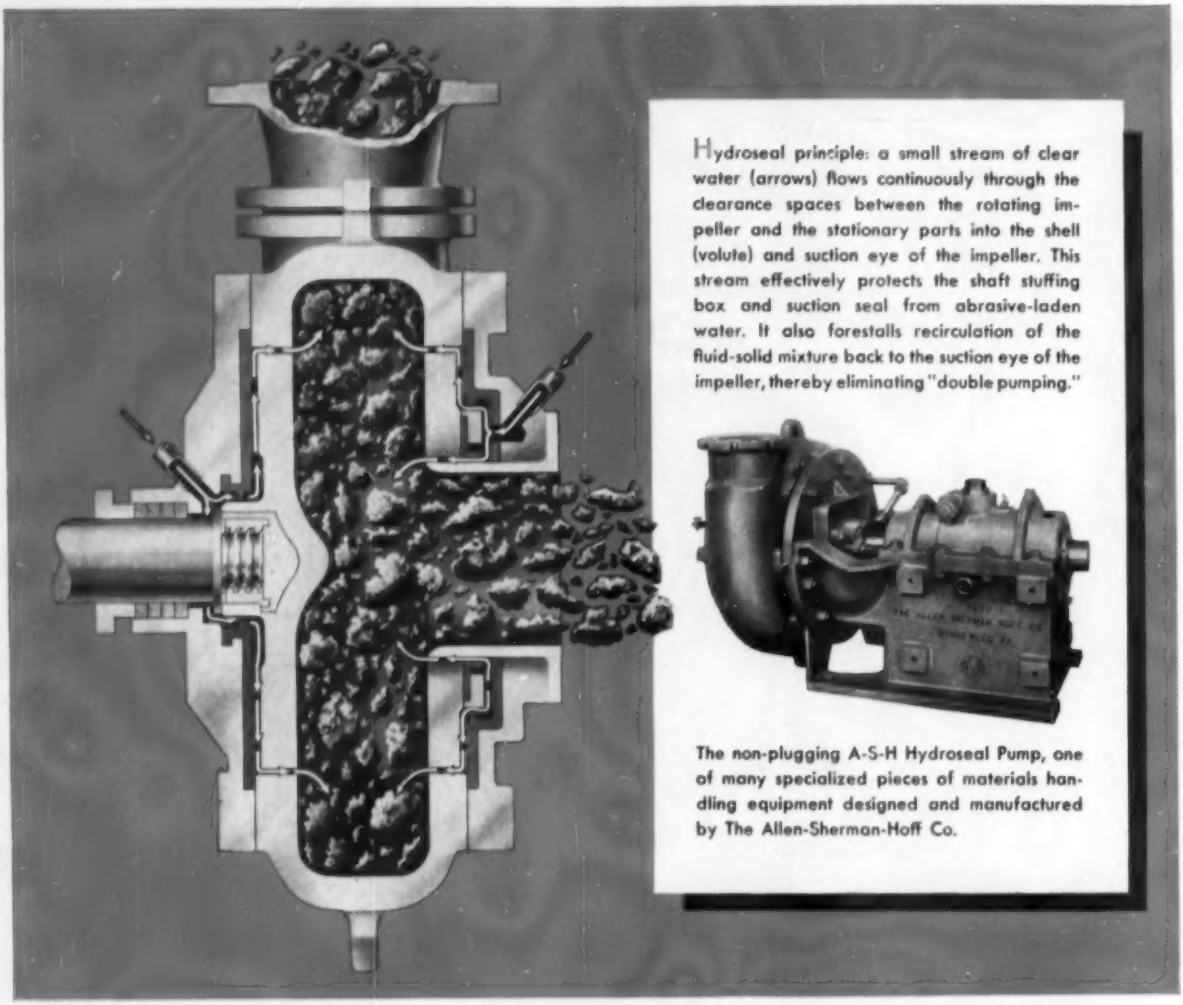


Hydroseal principle: a small stream of clear water (arrows) flows continuously through the clearance spaces between the rotating impeller and the stationary parts into the shell (volute) and suction eye of the impeller. This stream effectively protects the shaft stuffing box and suction seal from abrasive-laden water. It also forestalls recirculation of the fluid-solid mixture back to the suction eye of the impeller, thereby eliminating "double pumping."

The non-plugging A-S-H Hydroseal Pump, one of many specialized pieces of materials handling equipment designed and manufactured by The Allen-Sherman-Hoff Co.

A-S-H HYDROSEAL PUMPS... Best for handling abrasives

If you're plagued with abrasive materials handling problems, consider these advantages of the A-S-H Hydroseal Pump.

Maintains High Efficiency. A constant flow of clear water keeps abrasives out of the suction seal and stuffing box . . . protects them from damage. This Hydroseal water also eliminates "double pumping" by forestalling recirculation of fluid-solid mixture. Result: pump maintains initial efficiency, capacity and head for life of wearing parts.

Adaptability. Since there is no need to compensate for wear, any *fixed* pumping condition can be maintained without changing motor or pump speed. However, a simple change of V-belt drive ratio will adapt the same pump for a wide range of capacities and heads.

Rugged Construction . . . Low Maintenance. Wear-resistant chrome-nickel-iron alloy construction gives long life to shell and impeller. Replaceable rubber or metal liners protect engine and suction side bells. Simplicity of design affords easy dismantling and realignment of parts when servicing or repairing.

For complete technical information on the A-S-H Hydroseal Pump, write for your copy of Data Sheet Pa.

The **Allen-Sherman-Hoff** Company

259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS
hydroject *hydraulic* / **hydrovac** *pneumatic*

At U. of Maryland steam plant, coal is dumped through screens to hopper. After sizing, Link-Belt bucket elevator fills coal bin via screw conveyor on roof. Undercut chute allows reclaiming of coal from bin to truck when desired.

Link-Belt 24-in. apron conveyor feeds vibrating screen. Oversize is sent to ring crusher, from which it rejoins fine coal on belt conveyor en route to Link-Belt bucket elevator. Egli & Gompf, Inc., Baltimore, were the consulting engineers.

How coal handling lessons learned in big power plants

benefit a small boiler house

LINK-BELT engineering and equipment is your assurance of lowest cost per ton handled

BACKGROUND gained in large installations has acquainted Link-Belt engineers with every kind of coal handling problem. And small plants, like the University of Maryland's, benefit from that experience and Link-Belt's complete line of equipment.

Link-Belt, working with you or your consultants, can offer you a coal handling system of *proved effectiveness* —maximum simplicity, with no improvised engineering or erection headaches. Link-Belt knows and makes what it takes to do the job right—be it feeders, crushers, unloading equipment or any kind or combination of conveyors.

Whether your plant is large or small a Link-Belt mechanized coal handling system can save you money. Get in touch with your nearest Link-Belt office today.

You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding coal handling systems—both large and small.

LINK-BELT

COAL HANDLING EQUIPMENT

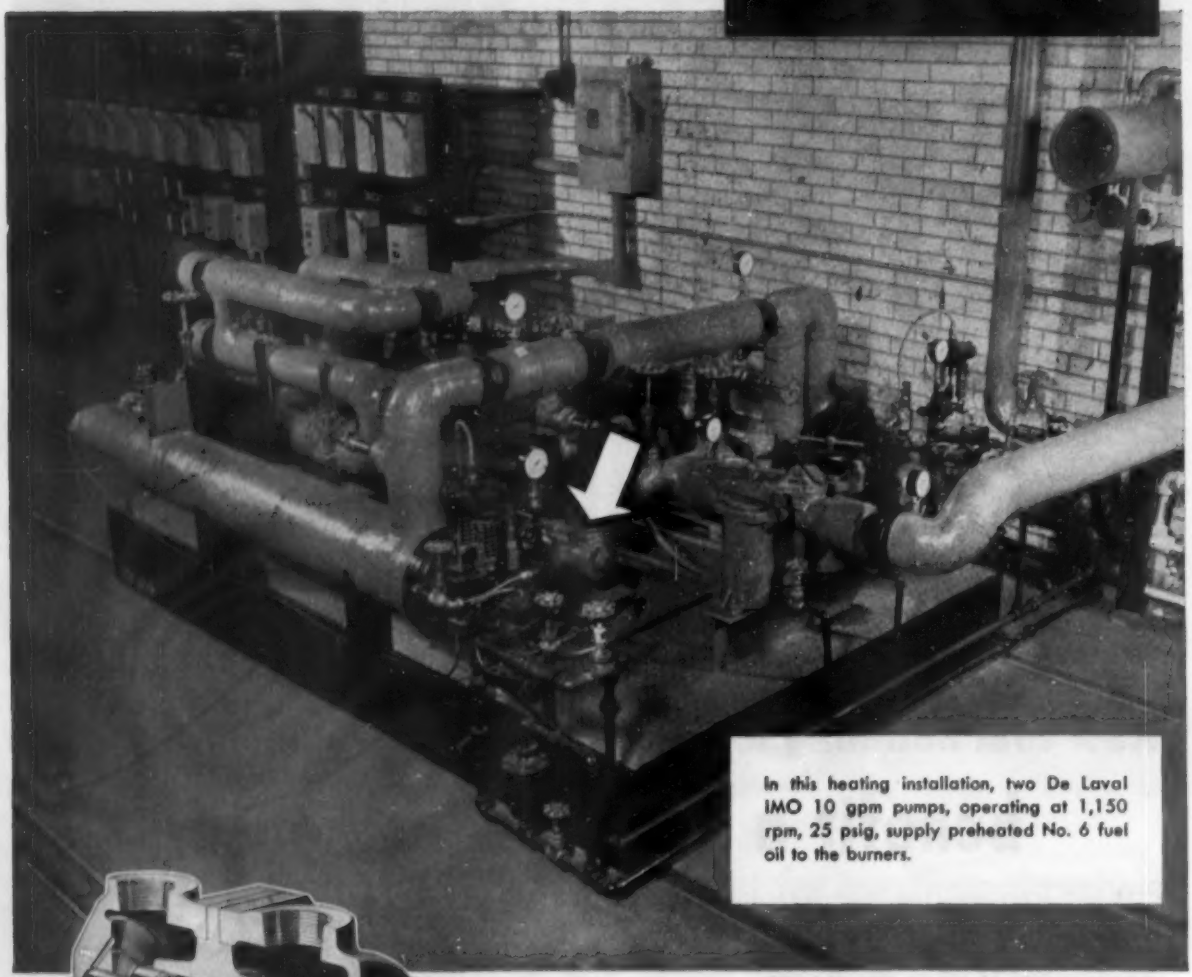
LINK-BELT COMPANY: Executive offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

19,704

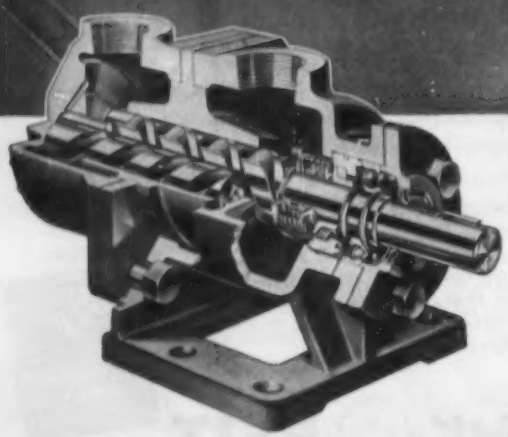
Contracts are more profitable when you install dependable

DE LAVAL

IMO PUMPS



In this heating installation, two De Laval IMO 10 gpm pumps, operating at 1,150 rpm, 25 psig, supply preheated No. 6 fuel oil to the burners.



A wide range of De Laval IMO models specifically built for fuel oil service is available. Capacities up to 80 gpm, pressures to 275 psig. Write today for Bulletin LG-A.

To increase your present—and future—profits on commercial heating jobs, install *dependable* De Laval IMO pumps on pump and heater sets. Their simple, trouble-free design saves you money on service calls . . . builds customer goodwill, for there's nothing to get out of order or need adjustment. No pilot gears, no sliding vanes, no reciprocating pistons. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation.

DE LAVAL *IMO Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DLS78

Power

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NOVEMBER 1955 POWER Vol 99—No. 11

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional Handbook statistical number in September, by McGraw-Hill Publishing Company, Inc. James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W. 42nd St., New York 36, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising; J E Blackburn Jr, Vice-President and Director of Circulation.

SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W 42nd St, New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. Position and company connection must be indicated on subscription orders.

Single copies: U. S. and possessions, Canada 50¢ (except mid-September Handbook $1.00); all other countries $1.50. Subscription rates—U.S. and U.S. possessions: $4.00 for one year, $6.00 for two years, $8.00 for three years. Canada: $6.00 for one year, $9.00 for two years, $12.00 for three years. All other countries: $15.00 for one year, $25.00 for two years, $30.00 for three years. Second-class mail privileges authorized at New York, N. Y. Printed in U. S. A.

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

MARMADUKE, that crusty horny-handed engineer of an era probably before the "old school," seldom gets a chance to break onto POWER's cover. This month, because of the yarn's nature (p 146) and the very sound lesson, we do show the story's sketch on the left side of cover.

The Marmaduke stories have been flowing freely for many years from the gifted pen and rich engineering background of Associate Editor Steve Elonka. The stories themselves are good fiction. But, more than that, we believe their chief claim to popularity is the high degree of practicality skillfully blended into each yarn. We also like to think these stories show POWER can be warm and human without losing usefulness to engineers.

"I always start my new issue of POWER by seeing what Marmy has to say" is a story we hear every day, whether from top management, shift firemen or maintenance men. We even get letters about Marmy from the wives and friends of engineers.

Next month . . .

Atomic Energy Today, a 24-page report, brings you newest data on nuclear fuels and reactors; how they are shaping up as core of tomorrow's nuclear power plants. Terms and concepts you may be dealing with shortly are spelt out in this upcoming report.

Chicago Skyscraper, the new Prudential Building, is backdrop for a December article on design of power services in a truly modern commercial building. Electrical distribution, water service, air conditioning, heating are examined in detail. Information is here on the 27 high-speed fully automatic elevators and world's highest escalators serving over 1,000,000 square feet of rentable space.

Electrical Safety is responsibility, in varying degrees, of every power man. Clip next month's article on this subject; pin it to your bulletin board. It may save a life.

. . . and future months

Continuous Oxygen Analysis is theme of an 8-page staff article in January issue. It includes details on available equipment, how to use it to advantage.

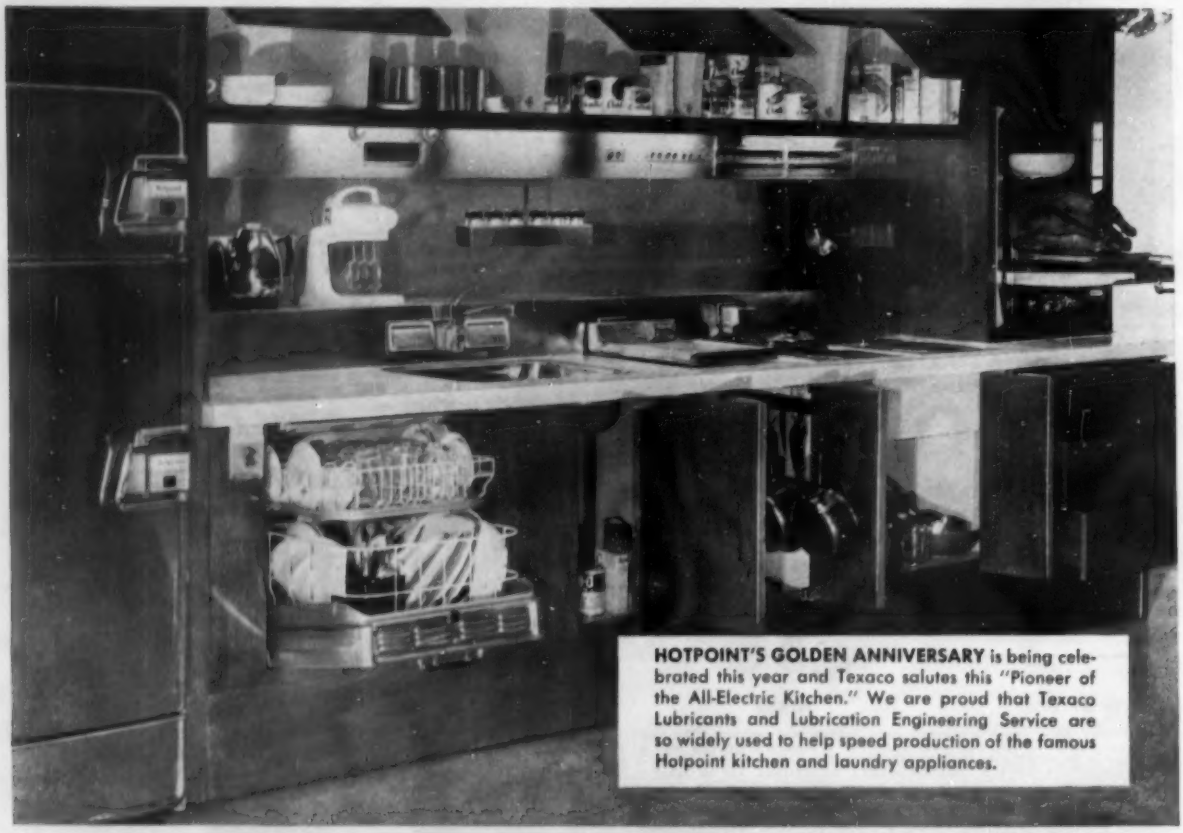
Cool savings for Hotpoint...

For the past five years, Hotpoint Co., Milwaukee, has been using *Texaco Regal Oil R&O* for all its turbine lubrication. And here's what L. E. Sweet, Plant Manager, has to say about it:

"Texaco Regal Oil R&O has done a consistently fine job for us. It keeps our turbine blower systems exceptionally clean — no sludge, no rust, no foam. The oil stands up in severe service, bearing temperatures are always normal and governor response always immediate."

Texaco Regal Oil R&O is a premium-quality oil. Special refining and effective additives *improve* its naturally fine properties, give it an extra long service life and enhance its ability to resist oxidation and prevent sludge, rust and foam.

There is a complete line of *Texaco Regal Oils R&O*. All meet the stringent requirements of leading turbine builders. A Texaco Lubrication Engineer will gladly help you select the proper one. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.



HOTPOINT'S GOLDEN ANNIVERSARY is being celebrated this year and Texaco salutes this "Pioneer of the All-Electric Kitchen." We are proud that Texaco Lubricants and Lubrication Engineering Service are so widely used to help speed production of the famous Hotpoint kitchen and laundry appliances.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring JIMMY DURANTE on television . . . Saturday nights, NBC.

speaking of Power

Where four editors are gathering info this fall

Editors keep up with zooming power growth

A Power editor travels for but one reason—to keep on top of the changing power picture. He may be probing unique problems facing power men in a specific locality. That means spending weeks talking to readers in their own plants, in consulting engineers' offices, in utility companies. His immediate job is done when he comes away with a clear understanding of their problems, a hatful of editorial ideas and, more often than not, a new article or two tucked under his wing.

Other times an editor travels to take an active part in engineering society meetings. Here he is working closely with engineers playing key roles in power progress. On still other trips, a POWER editor may be visiting equipment manufacturers, discussing new developments with their engineers and researchers.

West Coast is Managing Editor Jim O'Connor's fall target. Jim aims for new aspects of electrical design and operation in industrial plants on the Pacific Coast. He visits plants from San Diego to Seattle, chatting with top consultants, getting the current thinking of electrical manufacturers and key utility men.

Local Sections of American Society of Lubrication Engineers in Los Angeles and San Francisco heard O'Connor report on fire-resistant turbine lubricants. New developments in electric motors was Jim's theme in addressing San Francisco Plant Engineers Society. Several groups heard him on other subjects.

Mountain States are visited by Associate Editor Ben Skrotzki for latest thinking on solar energy. At the World Symposium on Applied Solar Energy in Phoenix, Arizona, top scientists exchange thinking on the feasibility of putting to work man's age-old dream—direct use of solar energy.

Leaving the solar group, Ben visits Hoover, Davis and Pole Hill Dams to get up-to-the-minute slant on local hydroelectric problems. Hopping to Chicago, he is Chairman, Gas Turbine Power Division during ASME Annual Meeting. Skrotzki is to receive a well-deserved kudos: Prime Movers Committee Award for his contribution at a previous outdoor-plant symposium.

Canada and Midwest are covered by Editor Lou Rowley and Assistant Editor Howard Kallen. Engineers at Canadian Power Show in Montreal heard Lou on future power engineering. Then after some plant calls, Lou swings to Chicago, joins other POWER editors at ASME Annual Meeting.

Kallen presents POWER's Modernization awards. He visits Ford Motor in Dearborn, Bendix Aviation in South Bend, Champion Paper & Fibre in Canton, North Carolina, and Garlock Packing in Palmyra, New York, to name but a few award winners.

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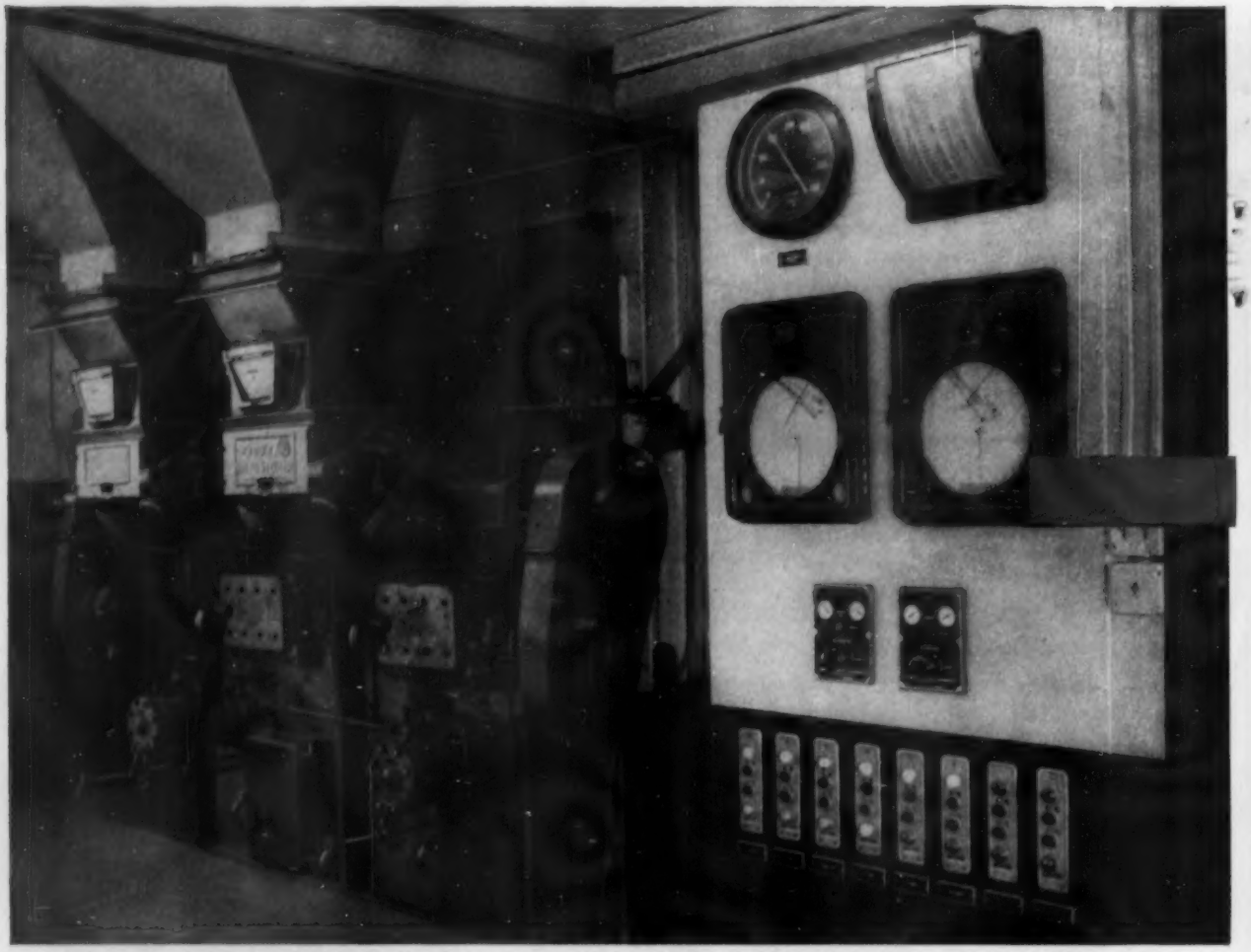


B&W Integral-Furnace Boiler with its control panel at Mill No. 3 boiler plant of Highland Park Manufacturing Company. Presently coal-fired with Detroit RotoStoker, the boiler is designed for future oil and gas firing. B. O. Vannort Engineers, Inc., are the consulting engineers for this installation.

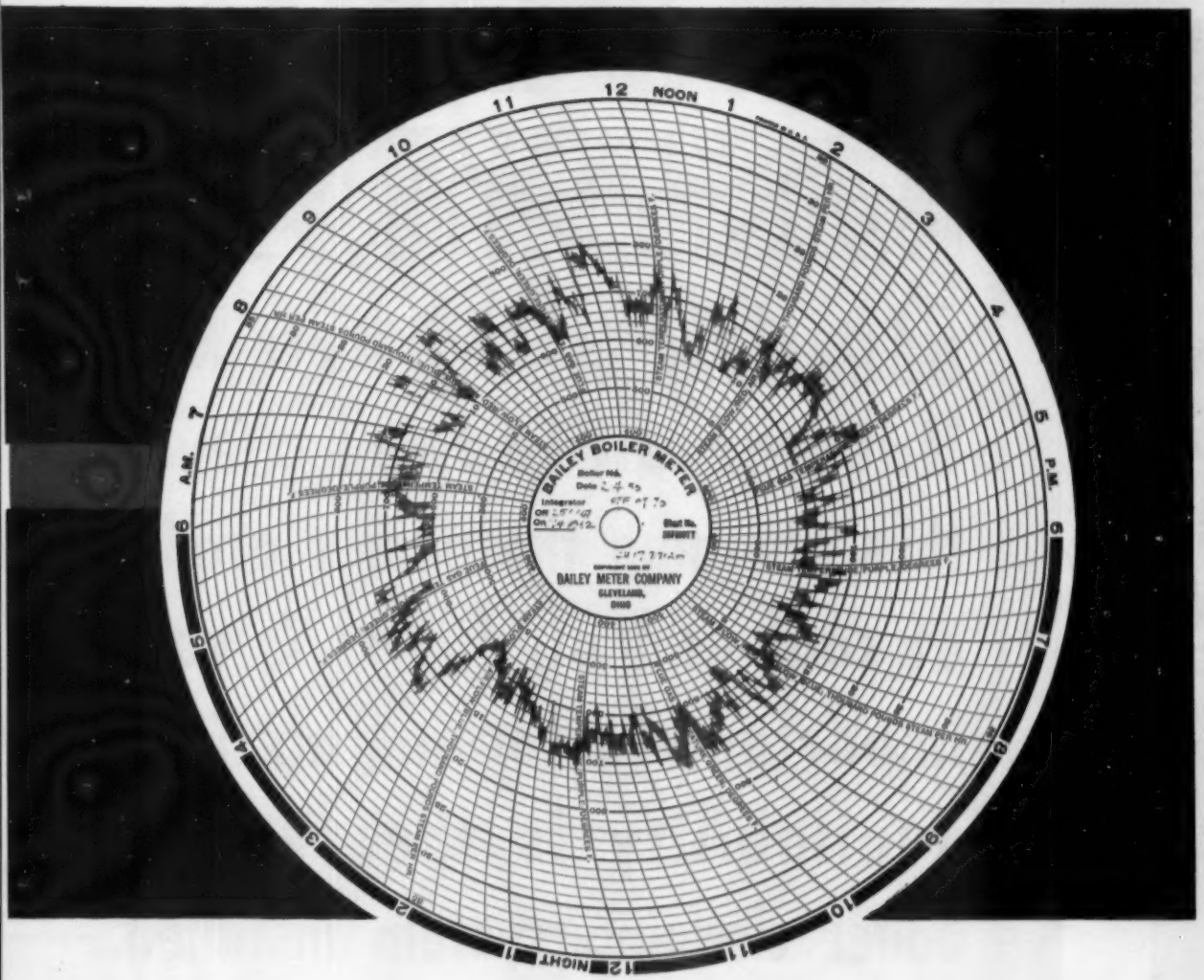
HIGHLAND PARK MANUFACTURING COMPANY

Saves 20% on

with a B&W Integral-Furnace Boiler

When a study of boiler plant costs confirmed that boiler and auxiliary facilities at Highland Park Manufacturing Company's Mill No. 3, were inadequate and costly, a B&W Integral-Furnace Boiler was installed to replace one of the two old steam units in the plant. Other charges and replacements, including steam piping and ducts and a coal-handling system, were made at the same time. And from the day the new equipment went into operation the boiler plant started to pay for itself. An indication of actual savings is shown by the 706-ton annual reduction in fuel consumption—a full 20 per cent saving and in itself strong justification for the plant's modernization.

The new B&W Boiler provides 25,000 lb of steam per hr, and 27,500 lb per hr to meet peak loads. Designed for a pressure of 250 psi, the boiler is currently being operated at about 150 psi. Coal-fired, it has provision for future installation of oil- and gas-firing equipment without disturbing the stokers, to derive full benefit from fuel price fluctuations. Also, this new unit assures a constant and reliable steam supply with quick response to the wide load swings common in the course of normal operation. It is equipped with complete controls, an alarm system and other protective devices to minimize manual operation and supervision. In addition to fuel savings, the Company reports overall



Fuel Alone

boiler efficiency consistently high, the plant much cleaner than before, and maintenance costs reduced substantially.

Highland Park Manufacturing Company and many other industrial plants in various categories have found B&W Integral-Furnace Boilers ideally suited to their steam requirements. If you are considering steam plant modernization or expansion to improve efficiency, get full details concerning B&W Integral-Furnace Boilers, available for steam requirements from 2900 to 350,000 lb per hr. Write to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

COST-SAVING FEATURES

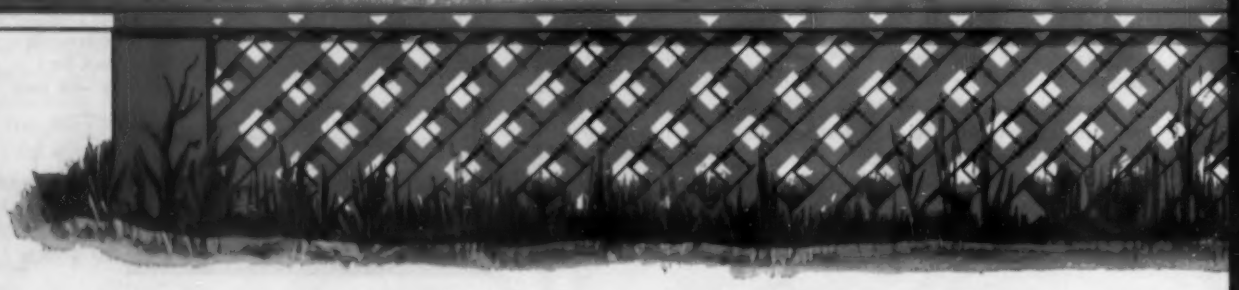
- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

G-707

Boilers with 95%+ Availability Are Not Uncommon Today . . . even those burning the poorer grades of coal and oil fuels. A very important factor in this high availability is the type of boiler cleaning system installed. Modern mechanized equipment, automatically controlled, pro-



vides uniform and effective cleaning of all surfaces on a scheduled basis. Many existing boilers with much lower availability resulting from surface and gas passage fouling can be improved greatly by a modest investment in modern **DIAMOND** cleaning equipment.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

MOTOR CONTROL FACTS
ON INDUSTRY'S
MOST COMPLETE LINE

FACT: Here is industry's newest and most advanced high-voltage starter!

This new line of Westinghouse high-voltage fused starters offers industry more protection—more operating simplicity than any other. Here are a few reasons why:

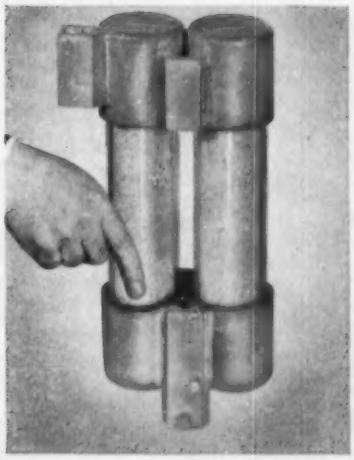
Extension of the BAL fuse line up to 400 amperes with the first and only 400-ampere, double-barreled, single-unit fuse; a new 50,000-kva air break contactor featuring the most advanced arc interrupting action yet developed; and new enclosures providing new levels of convenience and safety.

Booklet B-6535 has more facts on this outstanding new starter. Get it from your Westinghouse engineer —or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

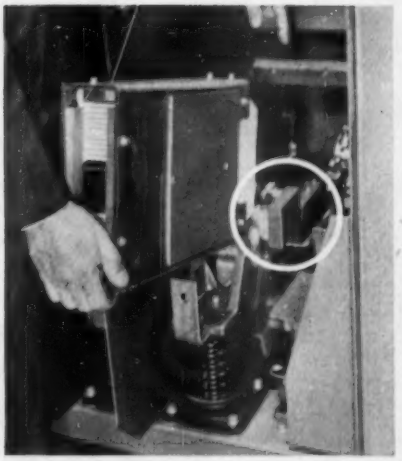
J-21898

YOU CAN BE SURE... IF IT'S

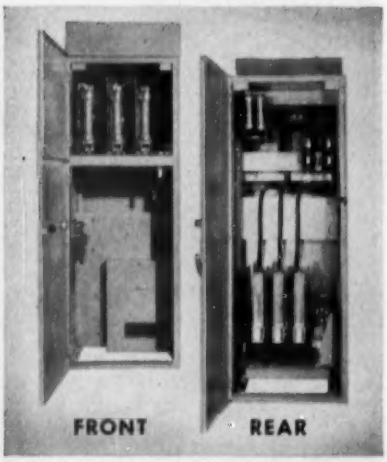
Westinghouse



New 400-ampere, double-barreled, type BAL fuse features "no-bolt" brazed connections which insure equal division of current. Complete coordination of fuses is assured. Exclusive BAL single-barreled design for fuses up to 200 amperes is retained.



New air break contactor (200 and 400-ampere sizes) features a unique arc chute design which greatly simplifies inspection and maintenance of the contacts. Simply pull the arc chute down —contacts are immediately and conveniently accessible.

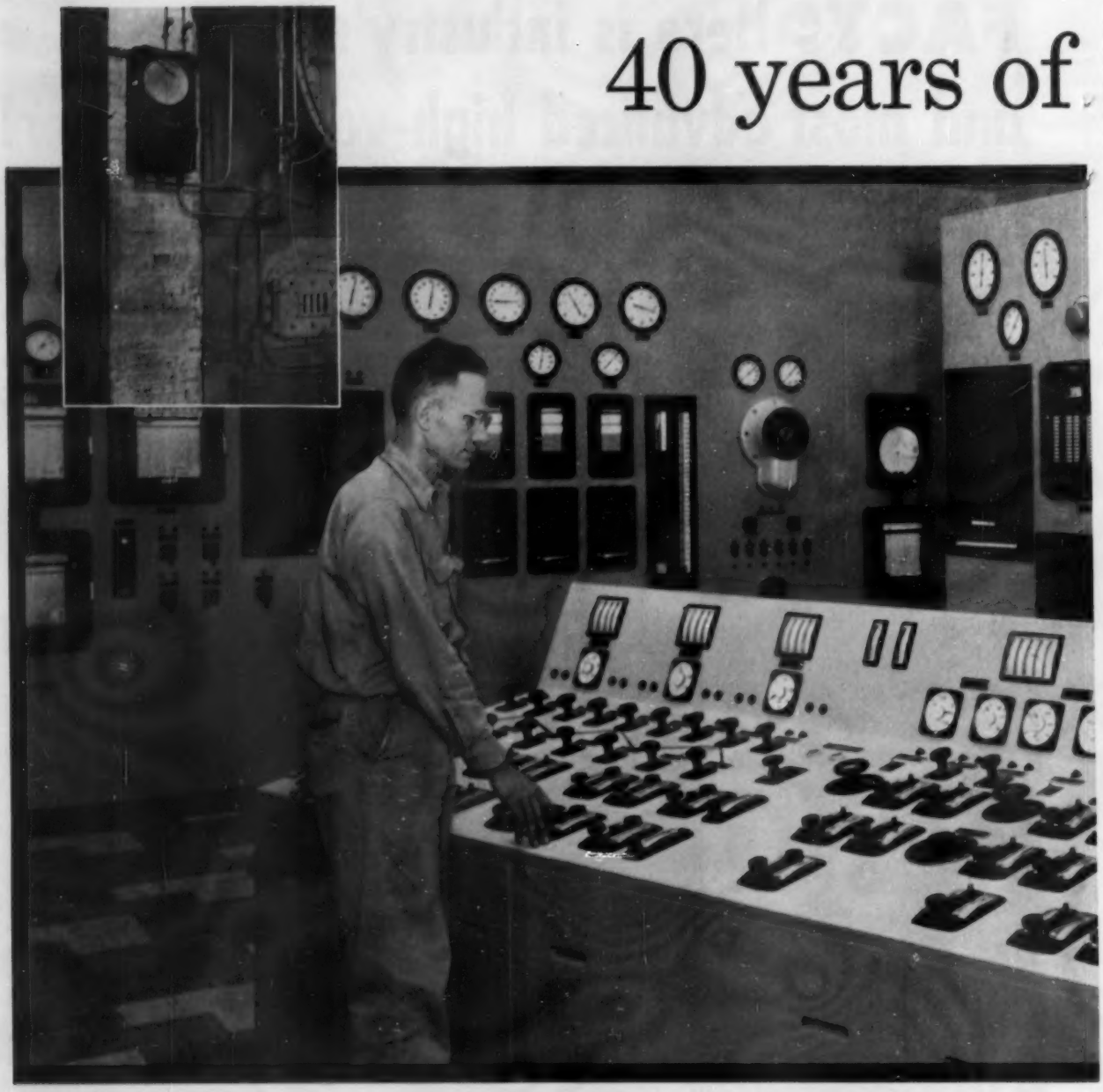


New enclosure design provides both mechanical and electrical interlocks; front and rear access DOORS; top-mounted bus arrangements; separate compartmentation of high and low-voltage components—all designed for maximum safety of personnel.

FROM INDUSTRY'S MOST COMPLETE LINE OF INDUSTRIAL CONTROL

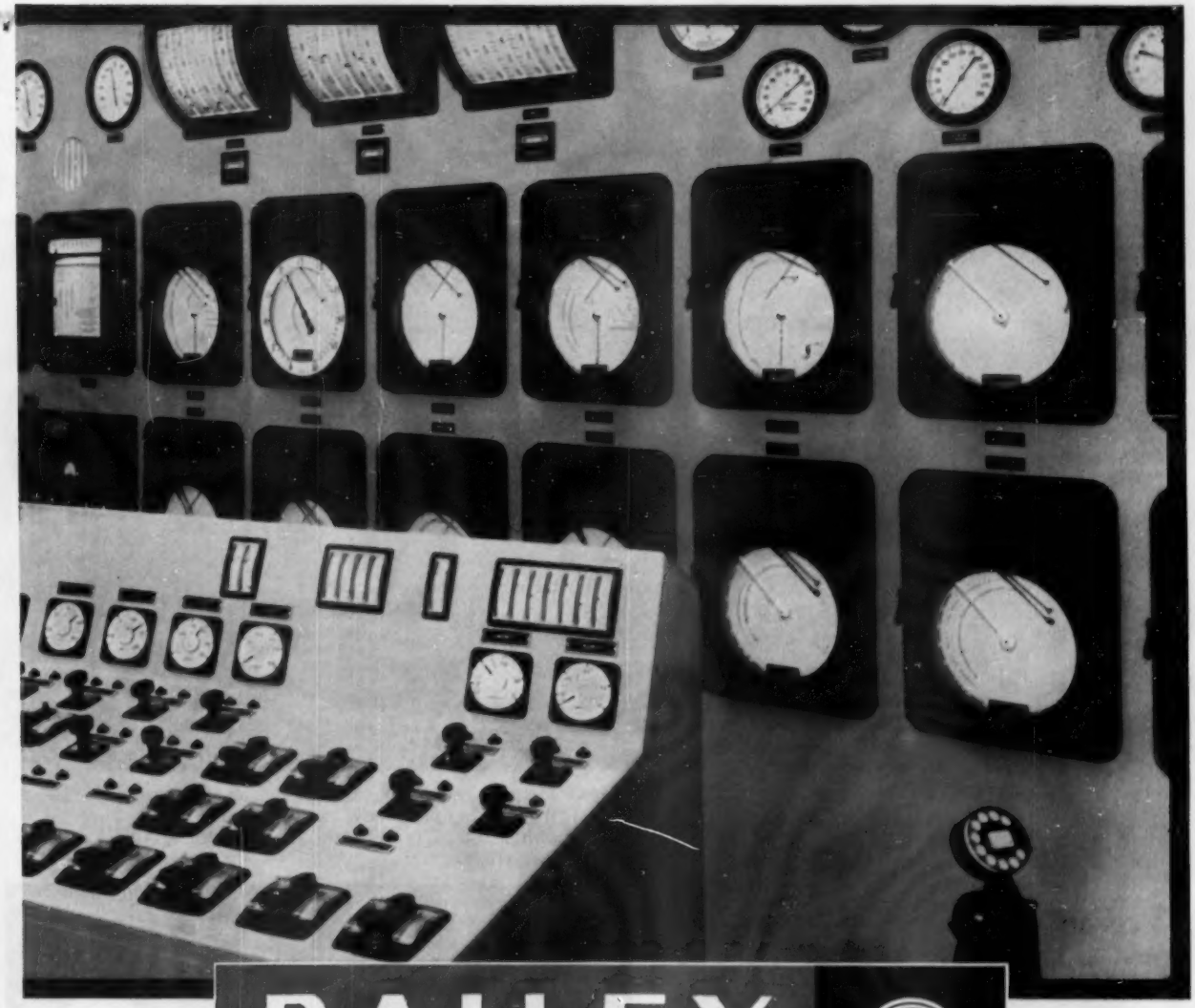
CONTROL COMPONENTS • MOTOR CONTROL • ELECTRONIC CONTROL • CONTROL SYSTEMS • NATIONAL SERVICES

40 years of



As ASME celebrates its 75th, Bailey Meter Co. completes its 40th year . . . The contrast between the Bailey installation of 1916 and the control room of today shows 40 years' progress in boiler control. In this progress, the completeness of the Bailey line has played its part, as has the breadth of Bailey Engineering Service . . . but most important has been a steadfast service policy of *making it work. That policy is expressed today in the most widespread network of Sales-Service Engineers provided by any manufacturer of boiler control systems,* sustaining the reputation of *the company built on service.*

"MAKING IT WORK"...



BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
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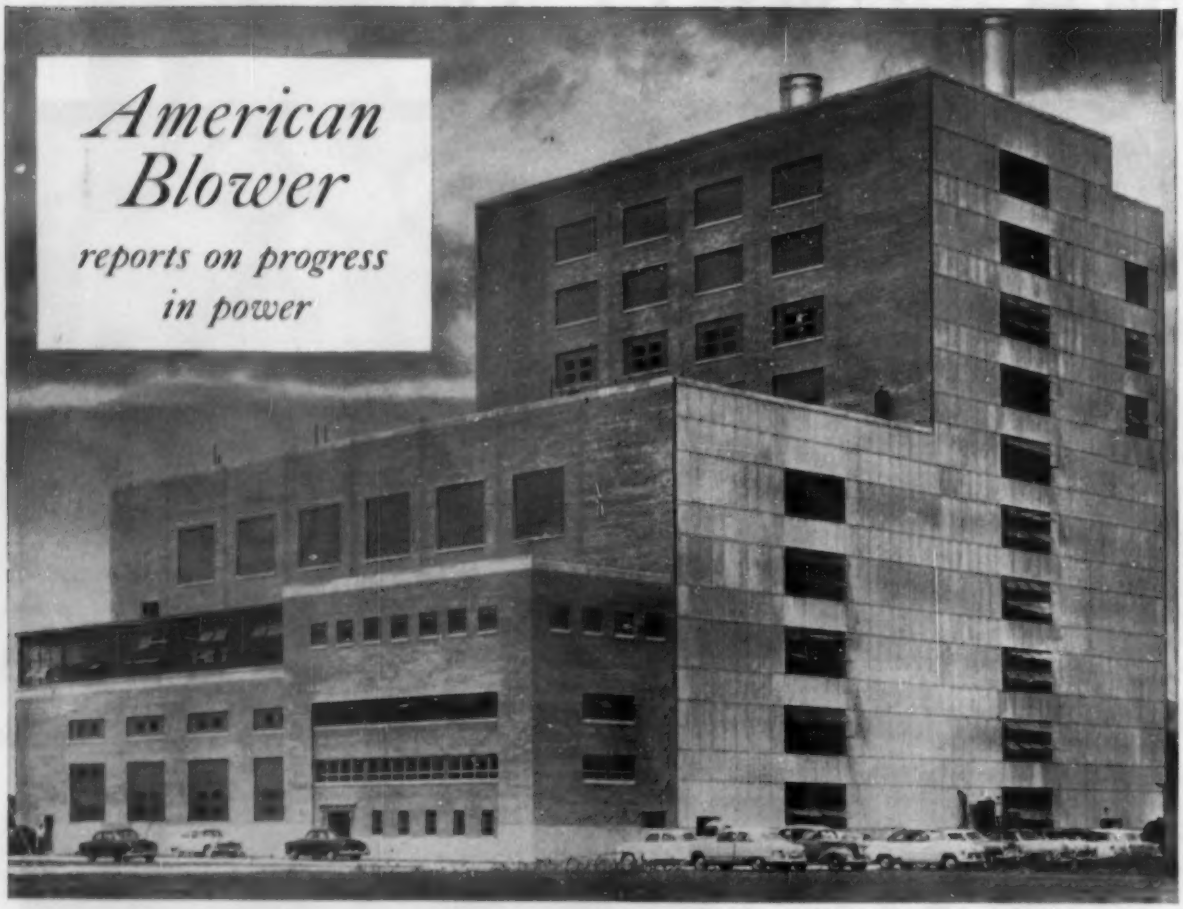
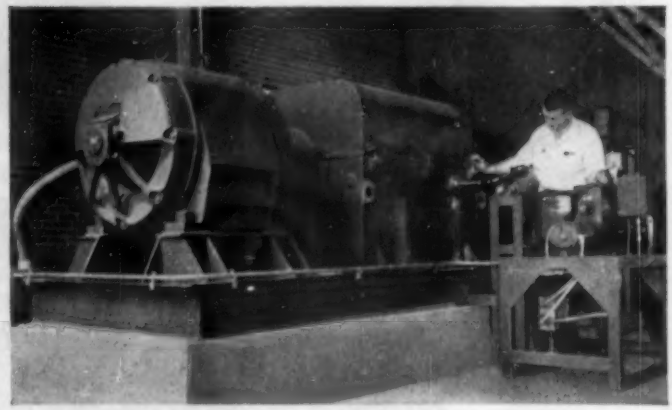
A127-2

Iowa Electric Light & Power's kw



Iowa Electric's new Sutherland Station, under construction at Marshalltown, will have two generating units. First unit, with 33,000 kw capacity, was completed in 1955.

American Blower Induced Draft Fans on Sutherland Station's new No. 1 unit are rated @ 97,000 cfm @ 356° F @ 11.75" sp @ 289.0 bhp.



Driving induced draft fan, American Blower Gyrol Fluid Drive – class IV, type VS – provides adjustable speed control; is rated @ 250 hp @ 870 rpm.

sales increase 356% in 17 years!

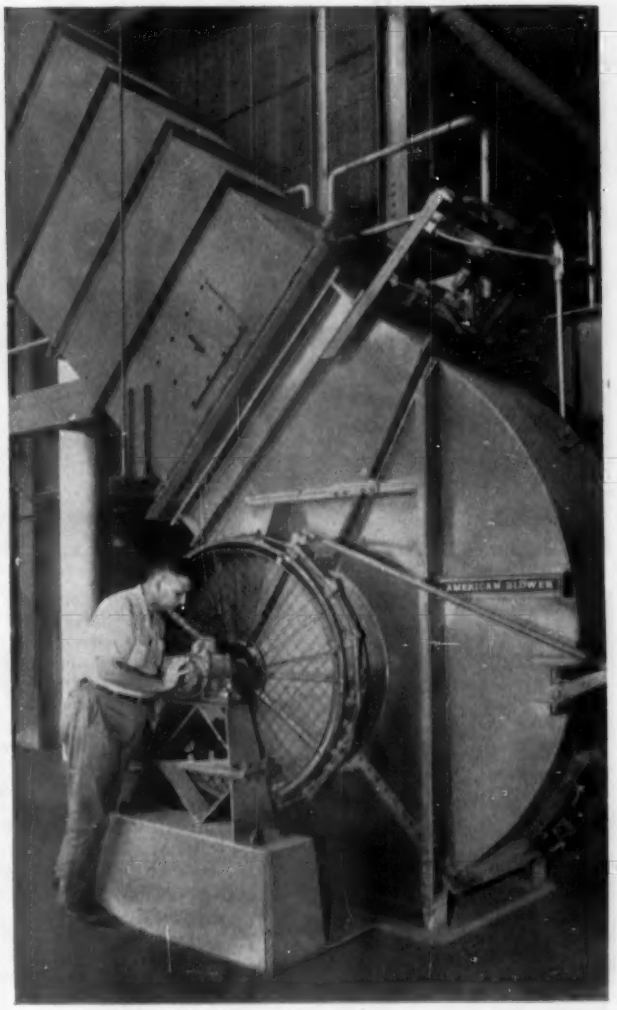
Relying on experience, rapidly expanding utility chooses American Blower air-handling equipment

1936 ushered in a phenomenal growth period for the Iowa Electric Light and Power Company. Fast-rising electrical needs called for new and larger facilities, longer distribution lines. Two mergers extended the company's operations. By 1953, 17 years later, Iowa Electric was serving 51 counties – and kilowatt-hour sales were up 356%! Today, Iowa Electric's facilities are still mushrooming. And the end is nowhere in sight!

Expansion has included new electrical generating units at the Boone and Cedar Rapids Plants . . . where American Blower Forced and Induced Draft Fans, Gyrol Fluid Drives, and a Fly Ash Precipitator were installed. This equipment has proved so dependable and free of maintenance that Iowa Electric again chose American Blower for Sutherland Station, its new plant at Marshalltown, completed in 1955 (first of two units to be constructed).

Experience has led many other progressive, investor-owned utilities to specify American Blower again and again, when expanding or modernizing. "There's no substitute," they report, "for the quality of American Blower Mechanical Draft Fans, Fly Ash Precipitators, Heavy-Duty Steam Coils, and Gyrol Fluid Drives for boiler feed pump and fan control." They rely on American Blower . . . you can too.

American Blower branch offices are conveniently located throughout the U.S. You'll find one of our representatives easy to contact – to discuss *your* problems.



No. 1 unit at Sutherland Station uses American Blower Forced Draft Fans, each with 57,500 cfm capacity @ 120° F @ 11.6" sp @ 138.0 bhp.

AMERICAN BLOWER CORPORATION
DETROIT 32, MICHIGAN

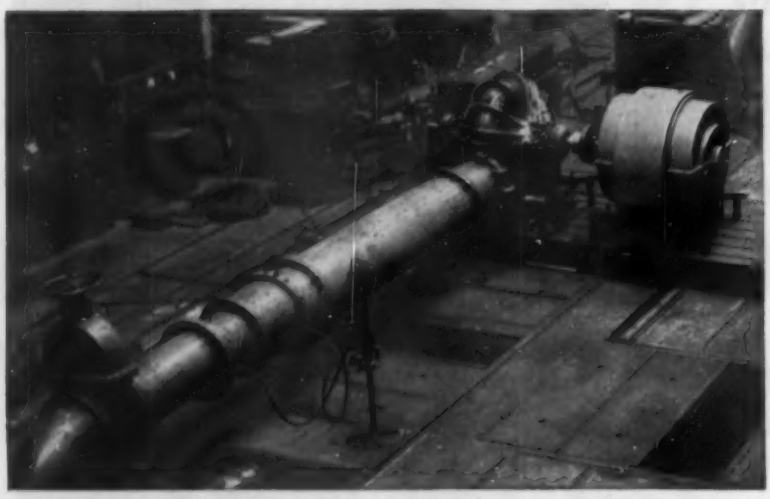
CANADIAN SIROCCO COMPANY, LTD.
WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Keep your eye on WORTHINGTON

Pump research primes pump progress



We have a lot of experience at Worthington—more than 114 years of it—and we're picking up more all the time.

But technology advances every day. Each step forward brings with it new and unsolved pumping problems. That's why Worthington's research and development program is continuous. That's also why we like to work with you during planning to get the jump on problems before they reach the costly stage.

Experts for every problem

For your day-to-day pumping problems, our sales engineers are thoroughly trained in pump applications in every field, and can usually supply the right answer fast. Naturally, for the really tough ones, our staff engineers back them up with all the equipment and facilities of our shops and laboratory. In addition, factory-trained trouble-shooters are available to cope with any problem that may arise in the field.

From cat-cracker to atom-cracker

Our specialists, covering all major industries, work as a team. Together, they bring to bear on any problem a vast store of experience. They've successfully solved pumping problems and helped pioneer new developments in public works, atomic energy applications, the oil industry, and the chemical industry —to name a few.

So keep your eye on Worthington; we probably have a money-saving answer to your pumping problems. C-41

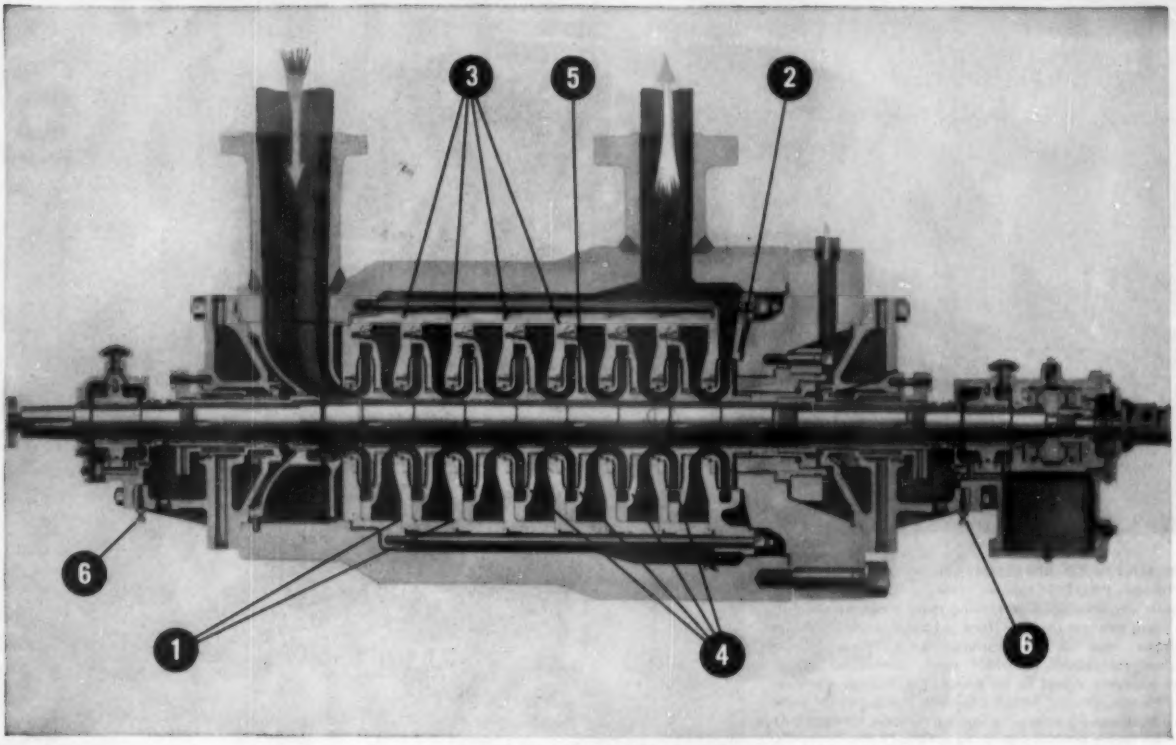
TEST STAND CAPACITY UP TO 100,000 GPM is provided at Worthington's Harrison plant *(above)*. Built over a man-made half-acre lake, the test stand is used as a production tool to check pumps from fractional horsepower up. This flexibility comes in handy—in one line alone Worthington can put together 60,000 different standard pumps out of 650 parts in six standardized sets of liquid ends.

DIRECTING PUMP TEST OPERATIONS from central control room *(left)* where special measuring instruments speed collection of performance data. Worthington pump specialists can afford to be objective in considering your pump application problem. They select from the most complete line of pumps offered by any manufacturer.

WORLD'S FIRST ATOMIC-POWERED SUBMARINE, *NAUTILUS,* undergoing sea trials. In atomic development since 1941, Worthington recently built special engine room equipment for both atomic submarines, *Nautilus* and *Sea Wolf*. Worthington continues to figure prominently in supplying this new field of atomic energy, keeping pace with its new and rapidly changing requirements.

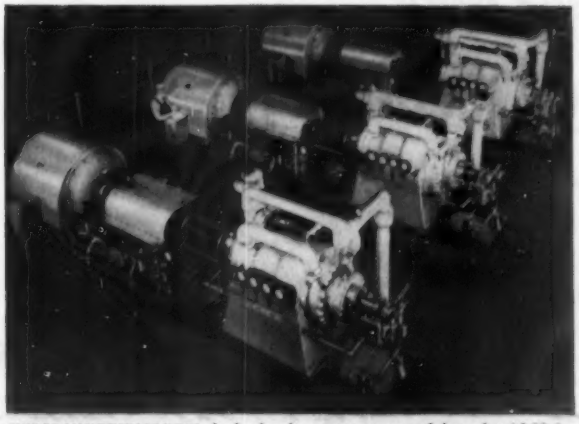
EUTECTIC CASTING, used in making standard Worthington pumps, frees engineer from casting restrictions. Formerly, design of impeller and diffuser blades had to allow hand withdrawal from fragile sand core. Eutectic casting uses a low-melting-point alloy to form blades, melting this alloy out during baking. This permits design flexibility for maximum hydraulic performance.

VITALITY OF WORTHINGTON RESEARCH PROGRAM is shown by the more than 300 articles in the technical press during the past five years by Worthington people. This flood of informative technical literature not only reflects our ability to keep pace with the changing hydraulic requirements for modern pumps, but also highlights the important contributions by Worthington to the knowledge of pumps.



WORTHINGTON high-pressure (over 1300 psi) boiler feed pump in cutaway view. Intake at left, discharge at right. Green areas show feed water path.

Look inside a Worthington high-pressure boiler feed pump



THREE WORTHINGTON six-inch, six-stage pumps, driven by 1250-hp motors through hydraulic couplings, feed boilers at Benning Station of Potomac Electric Power Company and help to provide power and light to homes and industry in the District of Columbia and portions of Maryland and Virginia.

They don't show on the outside, but here are seven basic features that are standard on Worthington high-pressure boiler feed pumps. They've been proved and improved over the 32 years since we pioneered the first high pressure centrifugal boiler feed pump. (Numbers are keyed to cutaway above):

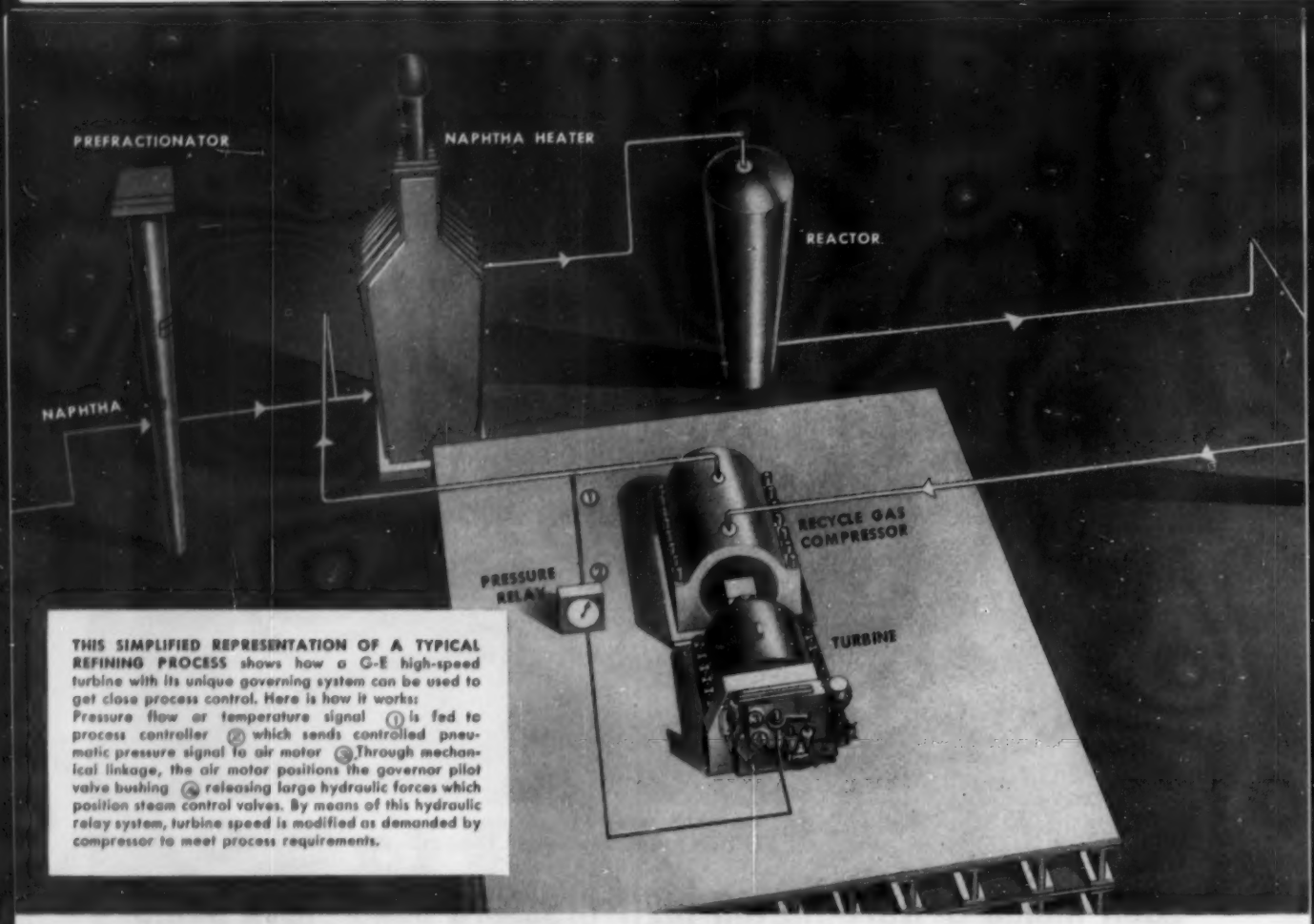
1. **ALL PRESSURE JOINTS** are metal-to-metal ring-type joints, the best construction for high-pressure service.
2. **INNER ASSEMBLY** firmly anchored at inboard end but free to expand with temperature changes and slide over centering fit in discharge head at outboard end.
3. **HYDRAULIC PRESSURE** acts to seal internal joints rather than open them.
4. **TWIN-VOLUTE** casing design has better hydraulic characteristics than common multiple vane diffusers while still eliminating radial thrust.
5. **ALL IMPELLERS** are shrunk on and keyed to shaft.
6. **VERNIER JACKSCREWS** at each end facilitate final adjustment of bearing centers.

Get the whole story on these high-pressure boiler feed pumps. Write for Bulletin W-319-B1D. Worthington Corporation, Harrison, New Jersey. C-5.1B

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE



THIS SIMPLIFIED REPRESENTATION OF A TYPICAL REFINING PROCESS shows how a G-E high-speed turbine with its unique governing system can be used to get close process control. Here is how it works: Pressure flow or temperature signal (1) is fed to process controller (2) which sends controlled pneumatic pressure signal to air motor (3). Through mechanical linkage, the air motor positions the governor pilot valve bushing (4) releasing large hydraulic forces which position steam control valves. By means of this hydraulic relay system, turbine speed is modified as demanded by compressor to meet process requirements.

EASILY INCORPORATED INTO YOUR PRESENT SYSTEM . . .

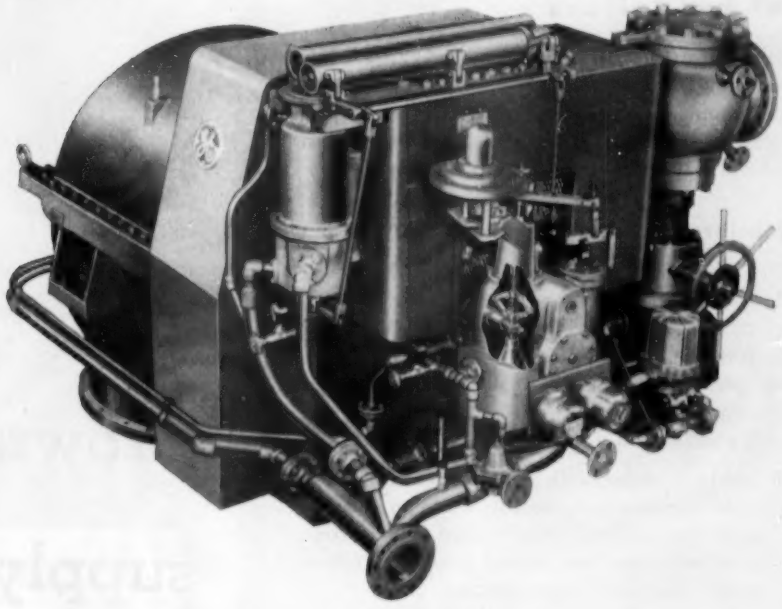
G-E position-restored turbine governing

HERE IS THE SMALL TURBINE AND SUPERCHARGER DEPARTMENT MARKETING TEAM that can show you how to apply all the advantages of G-E high-speed turbine governing to your process operations. R. E. Donnelly, Manager—Marketing, discusses a possible petroleum application with H. J. Chase, Manager—Engineering, at left, and C. B. Seelig Manager—Sales, center.

HIGH-SPEED TURBINES FOR ALL PROCESS APPLICATIONS

- PETROLEUM
- CHEMICAL
- PETROCHEMICAL
- STEEL

TURBINES FOR HIGH-SPEED COMPRESSORS . . .



THE GENERAL ELECTRIC POSITION-RESTORED GOVERNOR, shown cutaway above, utilizes the best features of both mechanical and hydraulic control. Heart of the system is a fly-ball-positioned, rotating pilot valve, which releases a tremendous store of power to position the steam inlet valves. The released power is controlled through feedback by a weight-biased mechanical-linkage that repositions the pilot-valve bushing only in direct response to movement of the steam-inlet valves, rather than in response to a force generated by the movement of the valves.

can give you close process control

In process industries, if quality-control and peak production are to be maintained, turbines that drive high-speed compressors and blowers must have close, accurate governing in response to load requirement and the slightest variations in steam conditions.

To help you get more precise control, all G-E high-speed turbines have a position-restored governor. It is an oil-relayed, mechanical-type control device that automatically matches turbine speed to process demands.

This governor will operate accurately and effectively with any recycle controlling system because the mechanical-linkage can be adjusted to match the complete output-signal range of any process controller. The G-E governor can be incorporated with a typical control system as shown in the schematic drawing.

FOR CLOSE PROCESS CONTROL the unique design of the G-E high-speed turbine governor offers these advantages:

Accurate signal relay results since speed changes are made through a weight-biased mechanical-linkage which repositions the pilot valve bushing only in direct response to movement of the steam-inlet valve. The system is not affected by oil-flow forces and is quick to respond to changes in process requirements.

Direct, precise speed settings are therefore possible because turbine response to process requirements is not dependent on force balance between springs and signal pressure.

Completely integrated governing responds not only to process demand but also to steam pressure or temperature changes, which must be factored in for close process control.

Position-restored governing keeps the system in near-perfect equilibrium, practically eliminating speed surges and turbine "hunting." Be sure to see how this governing system may be used to advantage in your process operation.

For more detailed information, contact your nearest General Electric Apparatus Sales Office or write General Electric Company, Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company, Limited, Toronto. 241-3

Progress Is Our Most Important Product

GENERAL ELECTRIC

"Dated" instruments drain away dollars

Instruments can become outmoded . . . just like automobiles and ideas. Progressive instrument development is constantly making many older designs obsolete . . . and such obsolescence can be a steady drain on profits.

Modern instruments save money

Honeywell engineers are proving this fact every day—in a growing number of plants, on all types of processes. Where out-of-date controls have been replaced by modern Honeywell instrumentation, economy-minded engineers and management men have really opened their eyes. And with good reason, for—

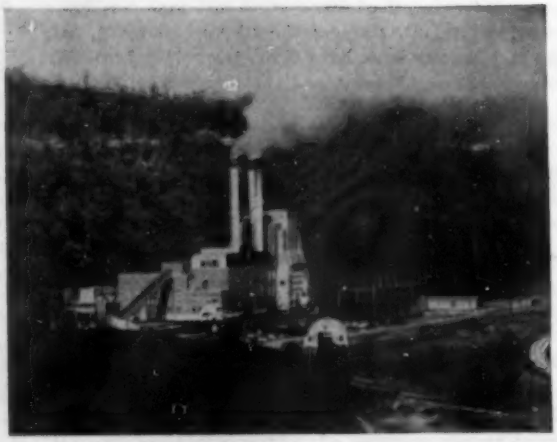
- Modern Honeywell instrumentation saves labor. Centralized control, automatic time-cycle systems, and other recent control concepts save countless wasted steps . . . reduce routine man-hour expenditures.
- Modern Honeywell instrumentation cuts maintenance costs. It affords longer, uninterrupted operation . . . is designed for easy service . . . requires minimum attention.
- Modern Honeywell instrumentation reduces rejects. It maintains the tighter process tolerances demanded by today's more exacting specifications.
- Modern Honeywell instrumentation improves product quality. Precision measurement and control remove any chance of error or guesswork in critical processes.
- Modern Honeywell instrumentation makes cost accounting more accurate than ever before. Everything is a matter of record.

An investment that really pays off

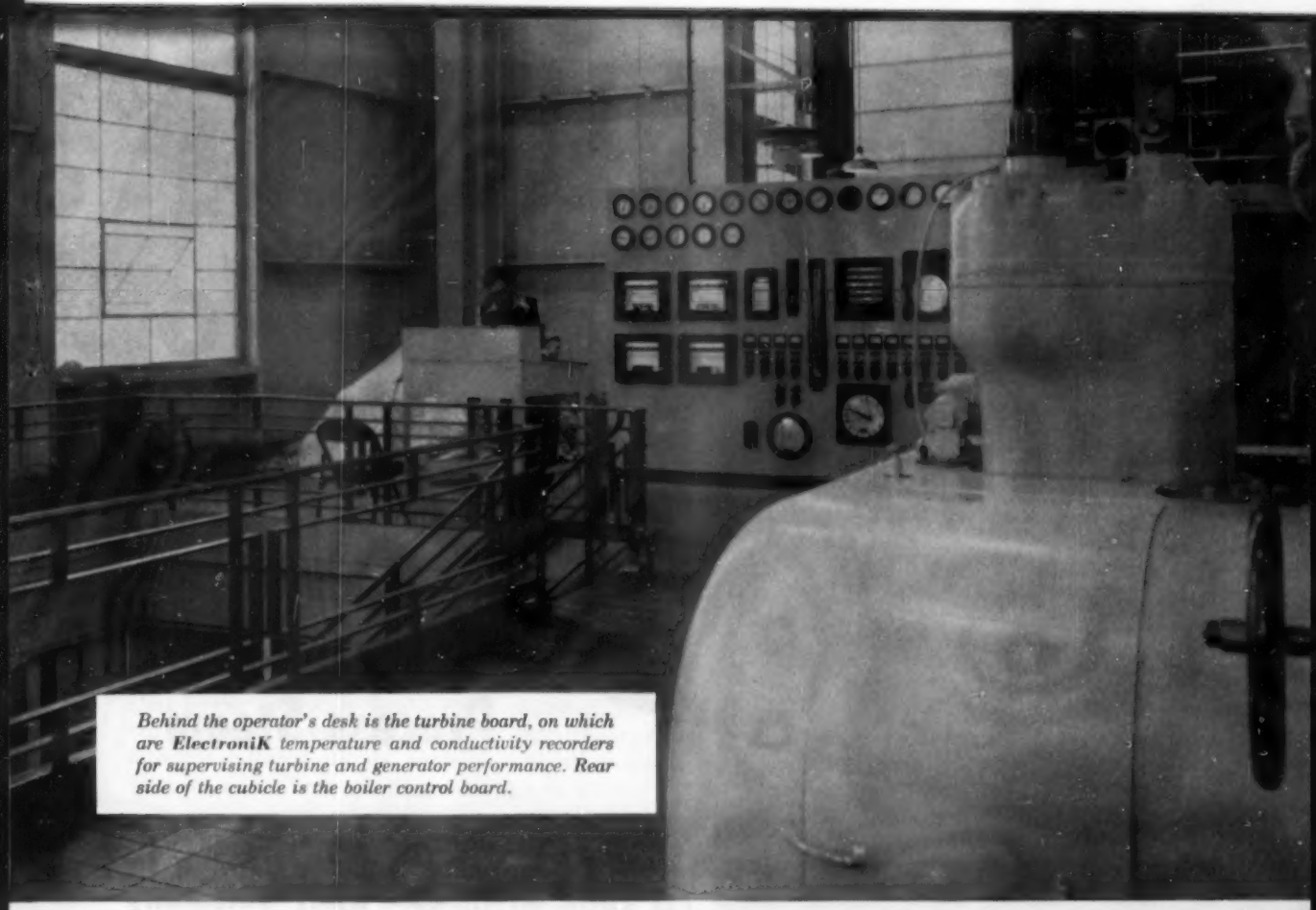
Just being "instrumented" is not enough. You can get more out of your instrument dollar, from both a product and service standpoint, with Honeywell instrumentation . . . the ultimate in engineering and design . . . insurance for your equipment investment.

Replacing with Honeywell is one of the best ways to invest your modernization appropriation. A Honeywell application engineer will gladly survey your present plant instrumentation . . . give you a practical recommendation that will make dollars and sense. Give him a call . . . he's as near as your phone.

Brown instruments supply vital data for operating 75-MW



General view of Kentucky Utilities' Tyrone Station. The 75-MW unit described here represents over half of the generating capacity of the station.



Behind the operator's desk is the turbine board, on which are ***ElectroniK*** *temperature and conductivity recorders for supervising turbine and generator performance. Rear side of the cubicle is the boiler control board.*

unit at Tyrone Station

MODERN INSTRUMENTATION TECHNIQUES have been utilized fully in the fourfold expansion that has taken place since the war in the total capability of the Kentucky Utilities Company. Typical of this trend is the control for the latest 75 megawatt unit added to the Tyrone Station (station design by Sargent & Lundy). The unit is equipped with comprehensive Honeywell instrumentation that gives operators centralized supervision of variables affecting safety of equipment and efficiency of output.

Boiler and turbine boards are mounted back-to-back on a single cubicle. On the turbine board are *ElectroniK* multi-point instruments which record temperatures of generator and turbine bearings, oil coolers, hydrogen coolers, condensate in hot well and heaters, and throttle steam. To keep watch on generator heating, an *ElectroniK* recorder charts temperatures at selected spots in the stator winding, and a single record instrument records rotor temperature. Another *ElectroniK* instrument provides a continuous check on condensate purity. All these instruments are equipped to actuate annunciators in the event that preset safe limits are reached.

Similarly, the boiler operating board includes *ElectroniK* instruments for recording steam conductivity as a means of preventing carryover and turbine damage . . . for checking heat-balance temperatures in preheaters, economizer, etc. . . . and for controlling recirculation of air through the preheater to guard against moisture condensation.

Your local Honeywell sales engineer will be glad to work with you and your consulting engineer on the application of this versatile line of instruments to your specific plant problems. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Bulletin 90-2, "Supervisory Instruments for Power Generation."

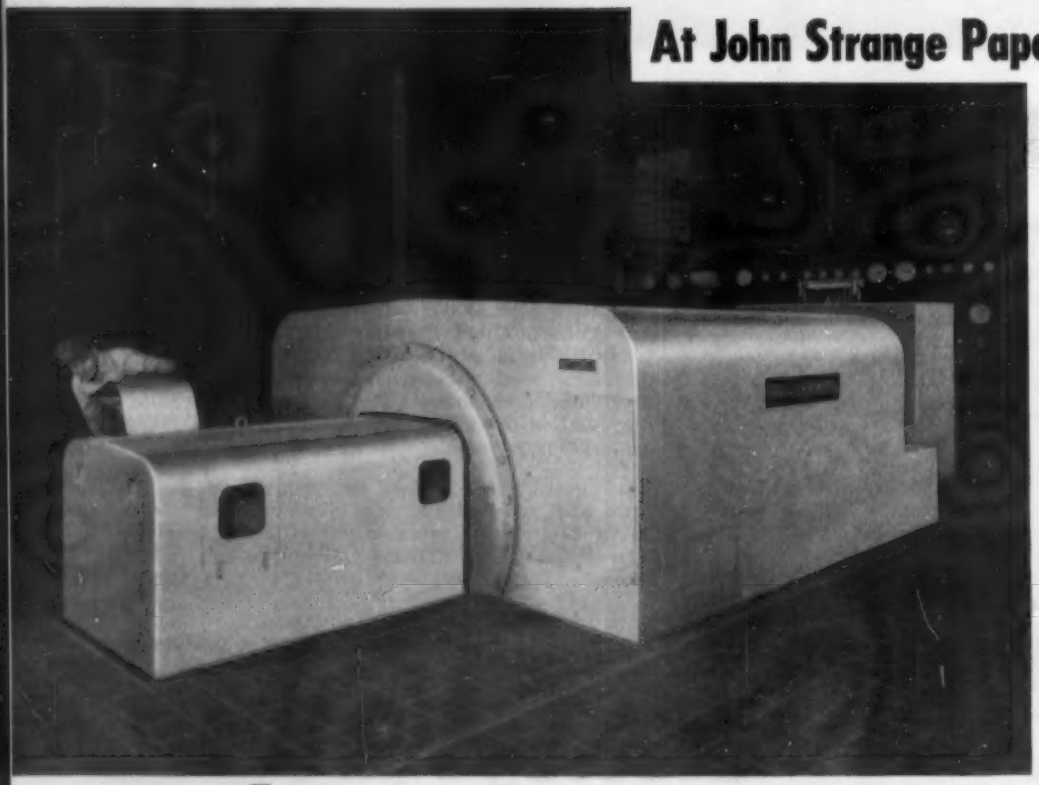
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

Paper Mills Choose for

WA-Series STEAM TURBINE GENERATOR UNITS

Produce Economical Plant Power as By-Product from Process Steam

At John Strange Paper Company



MENASHA, WISCONSIN

5000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of 150,000 lb per hour of process steam. Steam conditions at the turbine are 700 psig, 825 F, with 50 psig exhaust.

POWER SHOW — See Space 198 and 217, Chicago Coliseum, November 14-18.

ALLIS-

Allis-Chalmers Units Power Generation

The paper industry is a good example of many industries across the country that are choosing modern Allis-Chalmers WA-Series steam turbine generating units for plant power generation. Many installations are already operating in NEMA ratings from 2000 to 7500 kw. Recently, the line was extended to 16,500 kw in AIEE-ASME preferred ratings.

WA-Series units are available for condensing or non-condensing service, with or without automatic extraction, providing the kind of advanced design that power producers want. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets, and a time-proved governing system.

Engineered to Save Installation Costs

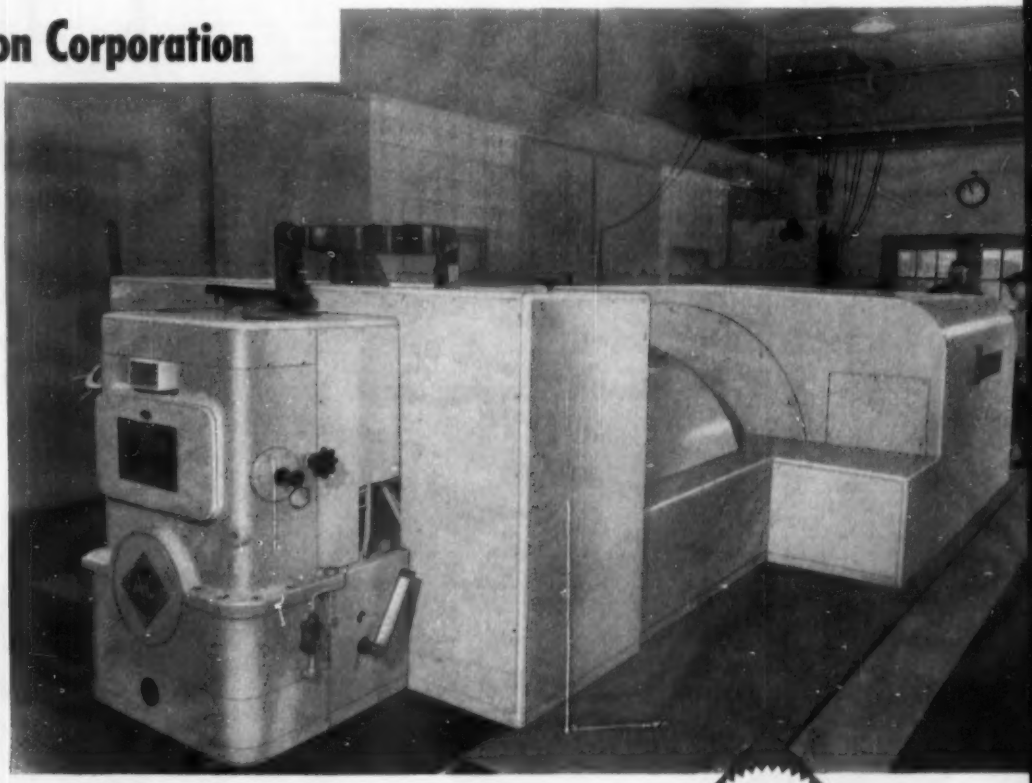
Particular care has been taken to promote ease of installation. Oil piping is above the floor line, eliminating need for trenches in the foundation. Generator gas coolers are located above the floor, eliminating ductwork through the foundation. Much of the work formerly done in the field is now performed in the factory. As a result, both turbine and generator can be shipped assembled ready for immediate installation.

For a detailed story on the advantages you can obtain with Allis-Chalmers steam turbine generating units, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 03B7654. A-4868

At Marathon Corporation

ROTHSCHILD, WISCONSIN

4000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of approximately 100,000 lb per hour of process steam. Steam conditions at turbine: 600 psig, 825 F, with 40 psig exhaust.

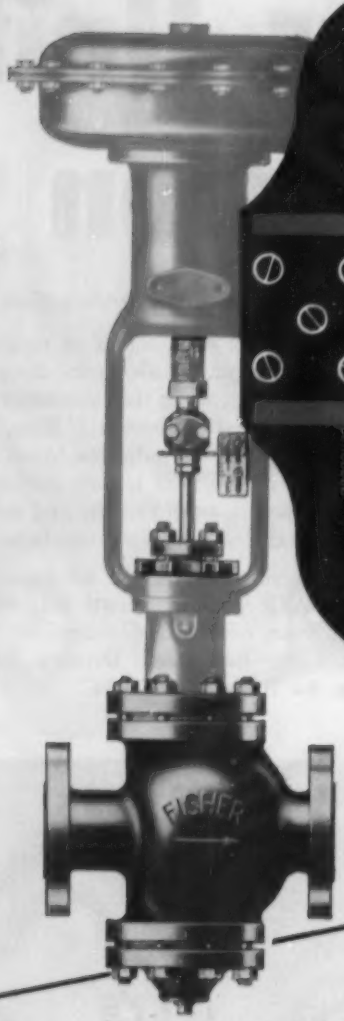


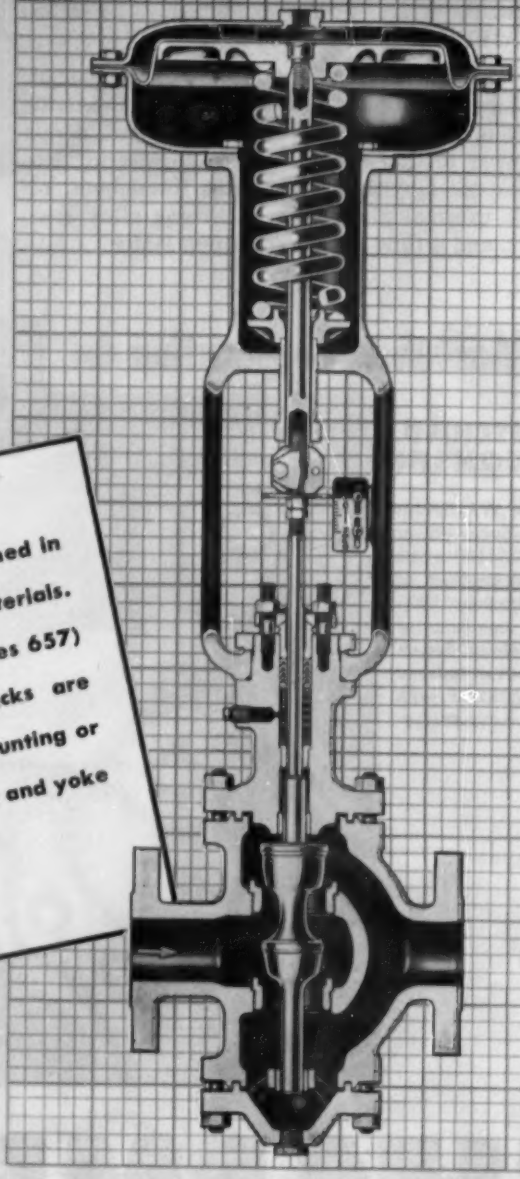
CHALMERS

A-C ALLIS-CHALMERS

FISHER®

DIAPHRAGM





● Fisher Diaphragm Motor Valves are furnished in a wide variety of pressure ratings and materials. Topworks may be either direct acting (Series 657) or reverse acting (Series 667). Handjacks are available for either diaphragm casing mounting or yoke mounting. There are six diaphragm and yoke size combinations.

Improved

MOTOR VALVES

Improved PERFORMANCE FEATURES

- Bolted-clamp type stem connection allows stem adjustment of 50% of total travel. Can be disconnected in the field without stem damage. Will not shake loose from vibration or rotational inner valve forces.

- Rugged body to yoke connection with hammer lug nut. Topwork can be removed without disturbing stuffing box.

- Specially designed Buna N molded diaphragms with Nylon insert retain superior flexibility at low ambient operating temperatures. Provides linearity between operating pressure signal and travel, and gives maximum effective area.

- Bolted gland stuffing box with Teflon packing.

- Stainless steel clear view travel indicator.

- Spring ranges: 3 to 15 psi; 6 to 30 psi.

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER

Our 75th ANNIVERSARY

Shaft power...heat...compressed air ...General Electric Gas Turbines offer all three

CAPABLE OF PRODUCING ONE, TWO, OR ALL THREE TYPES OF ENERGY SIMULTANEOUSLY, AN ECONOMICAL G-E UNIT CAN GREATLY SIMPLIFY YOUR OPERATION

General Electric Gas Turbines are already proving their economy and versatility in a number of industrial applications. If you haven't checked into the possibility of using them in your plant, chances are you may be missing a bet. One or more of the following characteristics can make the G-E Gas Turbine best for your operation.

Shaft Power is bound to be one of the primary requirements of your industrial operation. A variety of G-E Gas Turbine arrangements makes possible either a constant shaft speed or variable speeds down to 35% of rated rpm. A number of sizes, ranging up to 21,590 hp, are available.

Compressed air can also be tapped directly from the gas turbine compressor. While shaft power available for other uses decreases with the amount of compressed air you require, a considerable amount of both can be produced simultaneously. A recent study shows that a 5000-kw G-E unit could deliver 12,300 scfm of compressed air at 90 psia—and still have enough power left over to generate 2500 kilowatts.

Hot exhaust gas is another turbine by-product that can help your operation. Used as highly preheated air it can serve as a dryer, for instance, in cement and wood products plants. Or, finally it can generate up to 95,000 lbs. per hour of process steam in unfired boilers for petroleum, paper, chemical, rubber and other industries that require it.

Running virtually unattended, a G-E Gas Turbine needs no coddling. Furthermore, it has so few parts subject to wear that maintenance is ordinarily just a matter of routine check-up costing—according to one user—only 0.2 mils per kw-hr. When compared to maintenance expense for other kinds of complete power plants, this represents a considerable saving. Another company, reporting on the reliability of its 28 G-E Gas Turbines, states that the units have been available for operation 97% of the time—with forced outages averaging less than 0.1% over the past year.

Why not check into the benefits a G-E Gas Turbine might bring to your operation? For more details contact your nearest G-E Apparatus Sales Office or write for bulletin GEA-5516, General Electric Co., Section 261-6, Schenectady 5, New York.

GENERAL ELECTRIC GAS TURBINES OFFER INDUSTRY THESE ADVANTAGES:

SELF-CONTAINED POWER PLANT—needs no boilers, fans, etc.

VERSATILITY—can provide three types of energy: shaft power, heated exhaust gas, compressed air.

LOW FIXED CHARGES—simplicity of design means low installed cost.

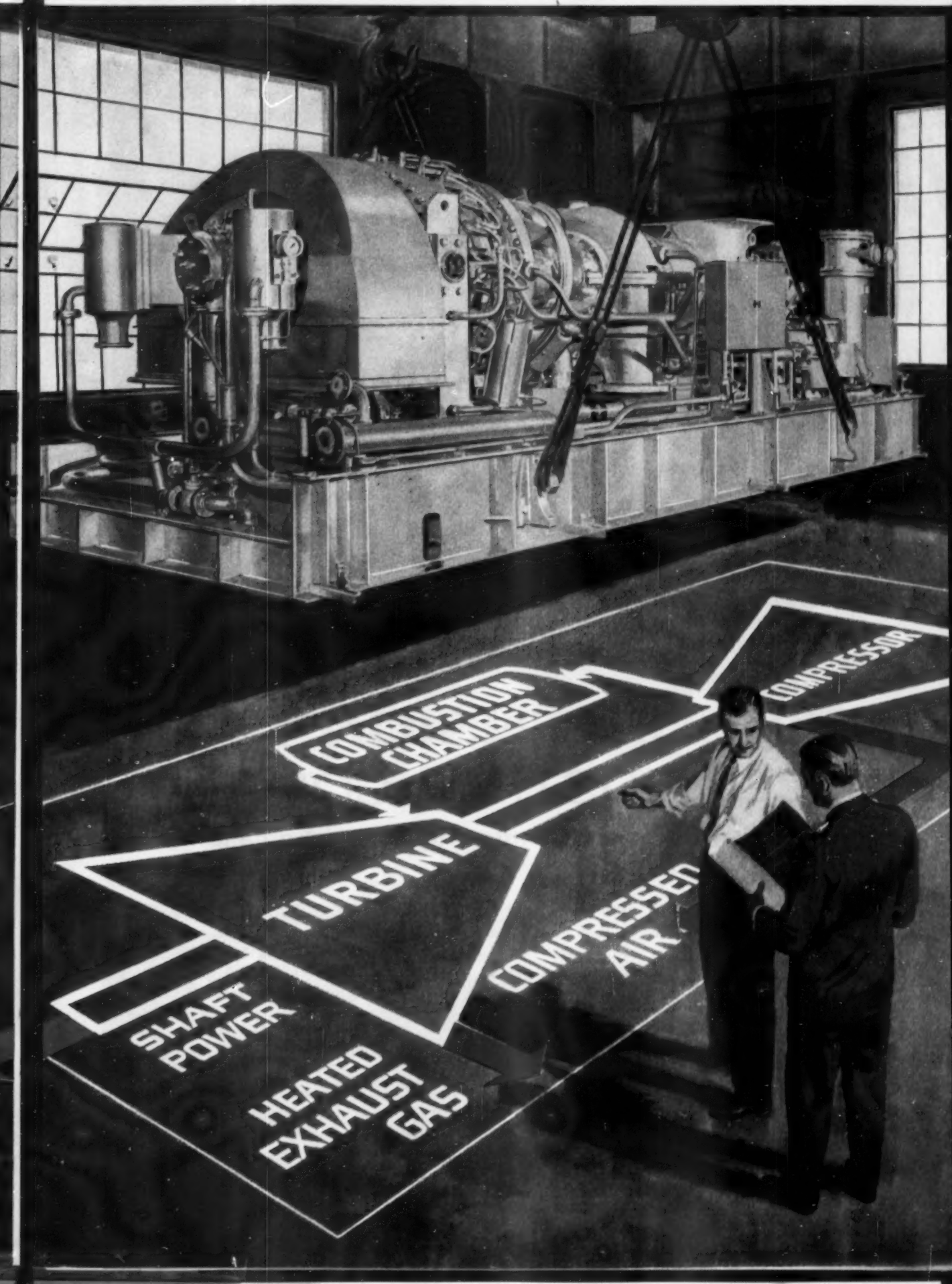
LOW OPERATING COST—runs virtually unattended; few wearing parts mean low maintenance cost.

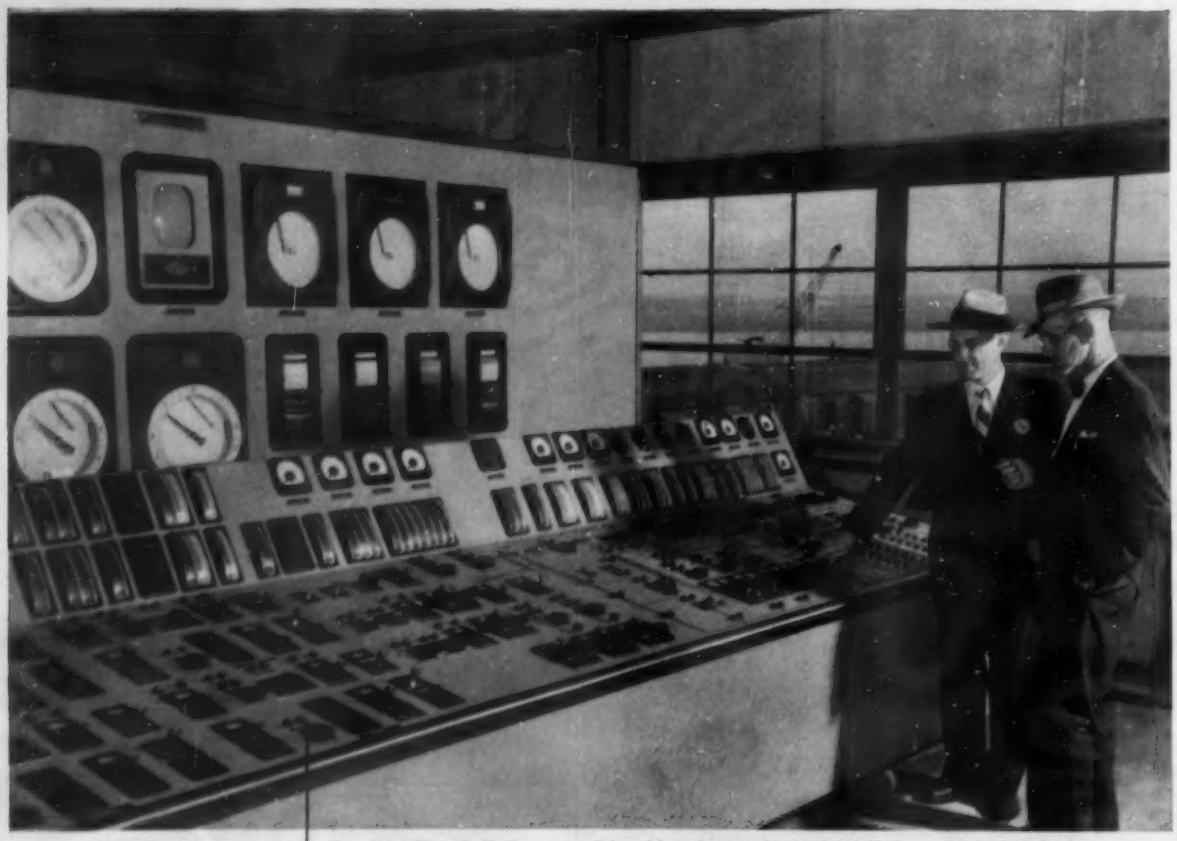
EXPERIENCE—G-E Gas Turbines have been in use since 1949. Now over 100 units have accumulated 95 turbine operating years.

QUICK INSTALLATION—units in most ratings are shipped on integral base requiring simple foundation and small area.

Progress Is Our Most Important Product

GENERAL ELECTRIC


COMPRESSOR
COMBUSTION CHAMBER
TURBINE
COMPRESSED AIR
SHAFT POWER
HEATED EXHAUST GAS



At Jersey Central Power and Light

A unique Hays built "two story" benchboard controls a 900,000 lb/hr multiple fuel fired boiler. Necessary control stations and miniature indicators are consolidated in a small space for one man operation, yet are easily accessible from inside the panel for servicing.

NEW DIMENSIONS IN COMBUSTION CONTROL

Dramatic results are being achieved by the nation's top

Today's boiler plant is only as efficient as the instrumentation which operates it. In selecting the correct equipment to assure completely automatic operation, to provide cost reductions through labor saving, and greater efficiency, the companies shown on these pages have looked to Hays. The newest in power plant design coupled with Hays workmanship and follow-through have given them the results they sought.

SKILLED FACTORY ENGINEERING

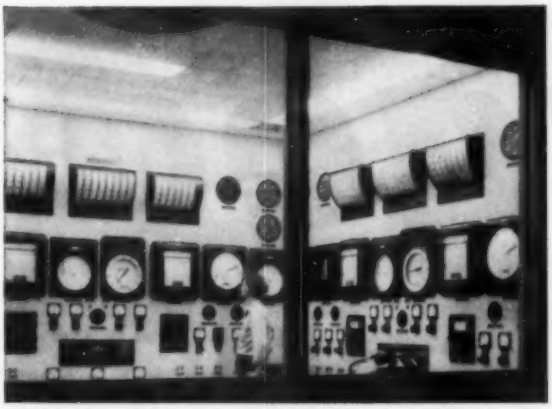
Hays systems are engineered to your specific requirements by a staff of specialists with years of experience on hundreds of boiler plants from the smallest to the largest. The particular instrument and control "package" necessary to handle your conditions is selected from the Hays product line; panel design, complete wiring, conduit, piping and control system diagrams are closely checked to see that they fit your requirements.

NATIONWIDE SERVICE

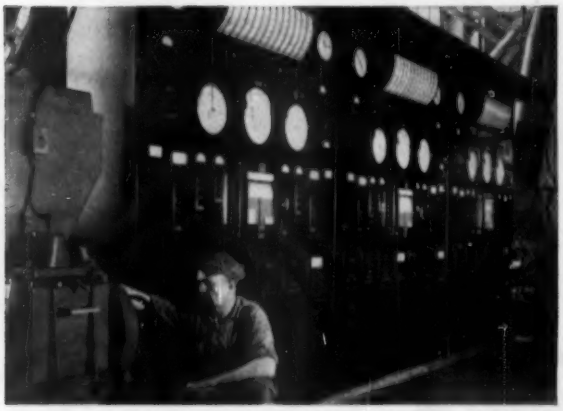
Service on Hays products is available throughout the country. Trained service engineers, from the factory or from Hays representatives in principal cities, can provide "start up" calibration and adjustment as well as subsequent periodic preventive maintenance service on your equipment.

For best results you will want to confer with Hays Sales Engineers in the earliest stages of your planning.

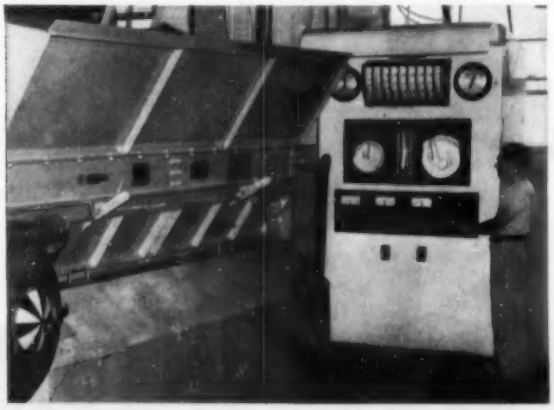
Write for complete information. Bulletin 55-605-83.



At Northern Indiana Public Service, the Hays system permits any desired allocation of load among three boilers, between the two cyclone furnaces of a given boiler and between the two fuels (coal and gas) being burned simultaneously in a given cyclone.



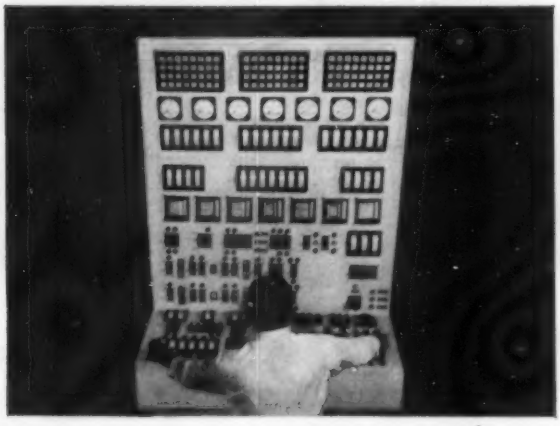
At Baldwin Locomotive Works, the Hays combustion control has aided substantially in saving 30,000 tons of coal per year and in reduction of maintenance. It is now possible to operate the power plant with 42 less men.



At Falstaff Brewing Corporation, modernization and Hays metering type control have resulted in boiler efficiency of 82%, fuel cost reduction of several hundred dollars per month, CO_2 up from 6% to 12%, and maintenance costs lowered 65%.

At Morton Salt Company, Manistee, Michigan, the fact that electricity doesn't freeze is vital in this semi-outdoor boiler which handles load swings up to 80,000 lb/hr at 85% efficiency with help of Hays electrically operated combustion control system.

utilities and manufacturing companies



At Louisiana Power and Light, a compact Hays B. T. G. control panel only 4 feet wide controls a giant 1,000,000 lb/hr boiler, turbine and generator! Instrumentation and control by Hays includes new electronic mercuryless flow meters and other electronic instruments for greater speed and accuracy.

THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Variflow Meters and Varitrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

rugged ... for

YARWAY UNIT TANDEM BLOW-OFF VALVE, combining Hard-Seat blowing Valve and Seatless sealing Valve in a common forged steel body. For pressures up to 1500 psi; hard-seat—hard-seat combination to 2500 psi. Welding connections shown. Flanged ends also available.

YARWAY

rugged blow-down service

YARWAY UNIT TANDEM BLOW-OFF VALVES

When boiler pressures are high you may not "blow-down" very often, but, man, when you do, you're glad those blow-off valves are rugged YARWAY Unit Tandems!

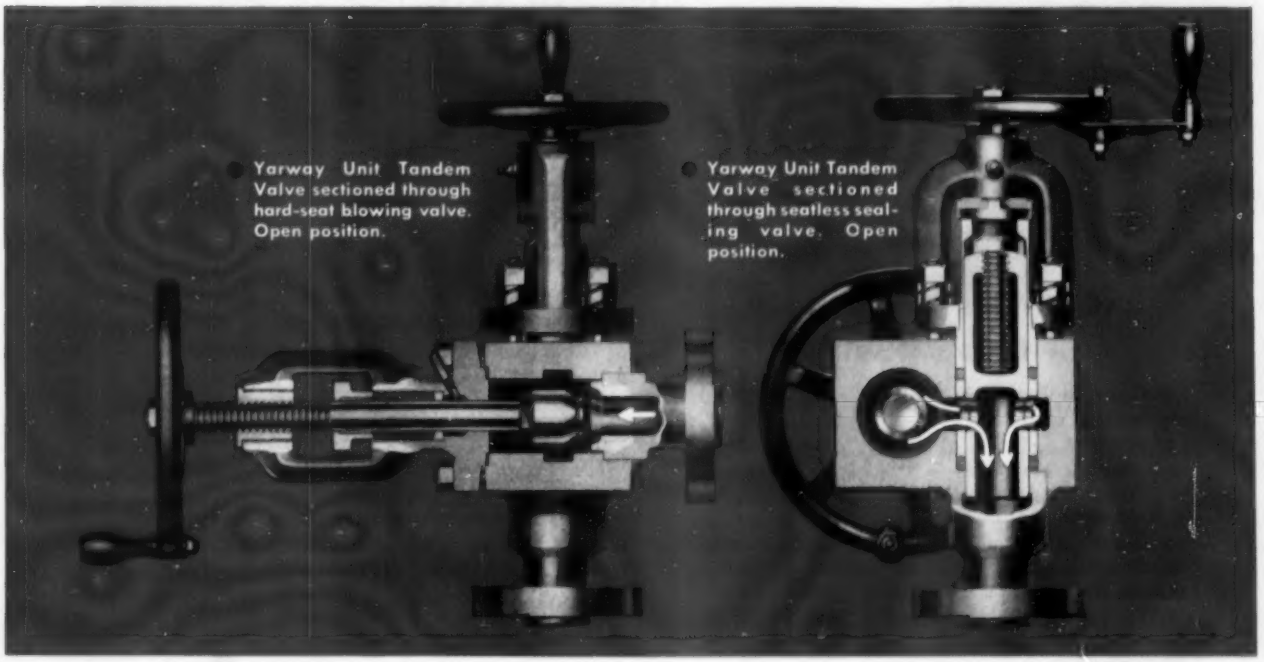
More than 80% of high pressure boiler plants are equipped with YARWAY *Blow-Off Valves,* and there's ample reason.

YARWAYS are strong, heavy-duty valves giving the important extra dependability needed for the severe combination of high pressures (hence high velocities), acid cleaning, and abrasion caused by precipitated solids.

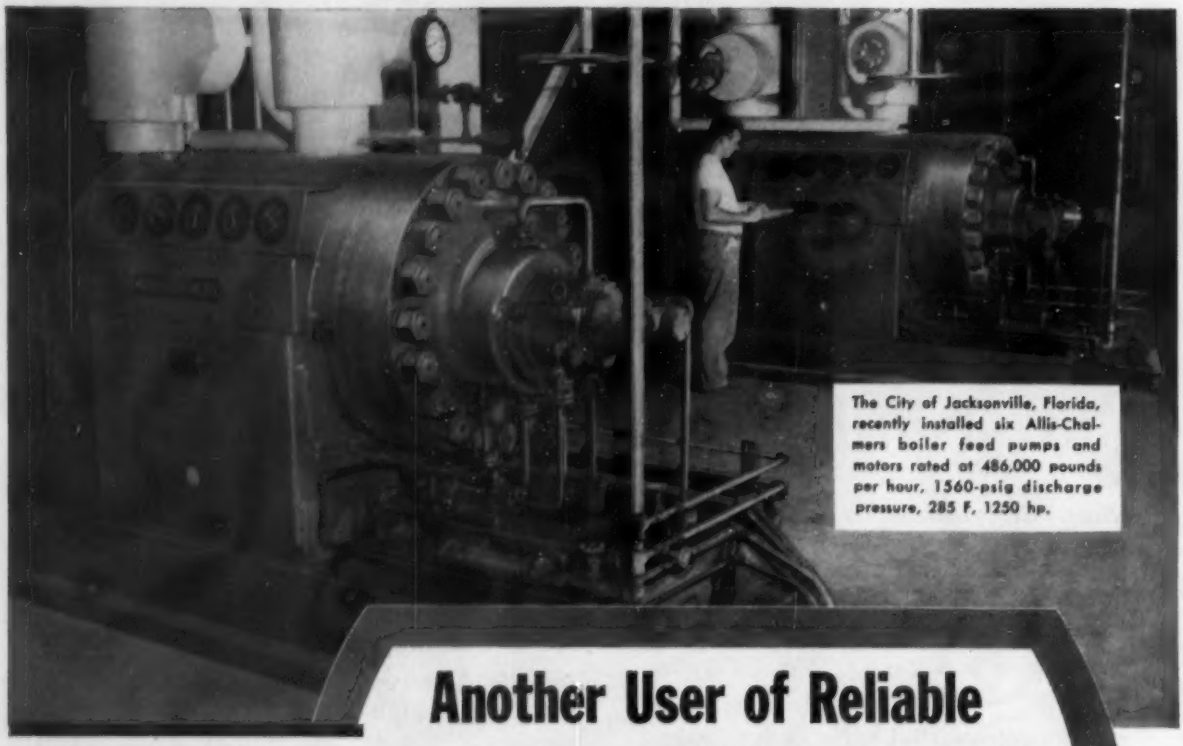
YARWAY Blow-Off Valves also are relied upon to keep boiler level within desirable limits during quick starts of high pressure boilers.

Specify YARWAYS—to protect *your* boilers. Write for Bulletin B-434.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES


Yarway Unit Tandem Valve sectioned through hard-seat blowing valve. Open position.
Yarway Unit Tandem Valve sectioned through seatless sealing valve. Open position.

— blow-off valves



The City of Jacksonville, Florida, recently installed six Allis-Chalmers boiler feed pumps and motors rated at 486,000 pounds per hour, 1560-psig discharge pressure, 285 F, 1250 hp.

Another User of Reliable ALLIS-CHALMERS barrel-type PUMPS

City of Jacksonville

Here are the reasons **for wide acceptance of these pumps:**

- Outstanding performance — fully proved by service records.
- High efficiency and smooth operation under fluctuating loads — first stage has twin, single-suction impellers for low NPSH requirements.
- Simple maintenance—expansion joint and shaft seals are brought to outside of pump where they can be easily inspected.
- No balancing device needed—axial balance is maintained by back-to-back mounting of the impellers.

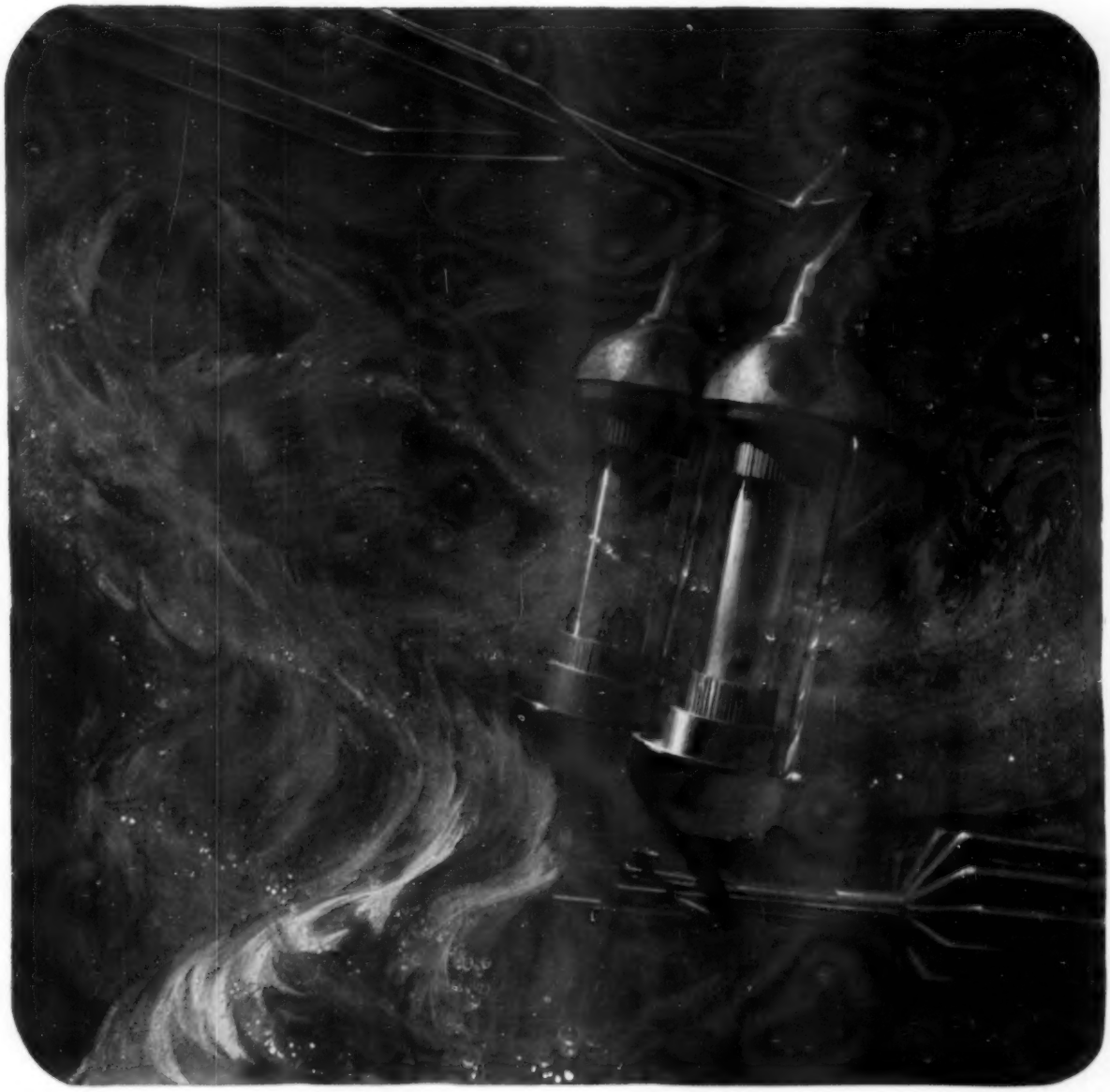
THERE are outstanding features like these throughout the Allis-Chalmers line. Whether you require boiler feed, condensate, circulating or other power plant pumps — it pays to standardize on Allis-Chalmers.

In addition, A-C can supply pumps, motors and control of coordinated design and manufacture. This means one responsibility — one guarantee of satisfaction.

Get complete information on barrel-type boiler feed pumps. Call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4854

ALLIS-CHALMERS



Kidney for an Atomic Fish

Something the Nautilus, U. S. Navy atomic-powered submarine, must have is chemically pure (ion-free) water. A "kidney" like the one shown above, with MONOBED® ion exchange resins as its innards, keeps water used free of even traces of dissolved salts.

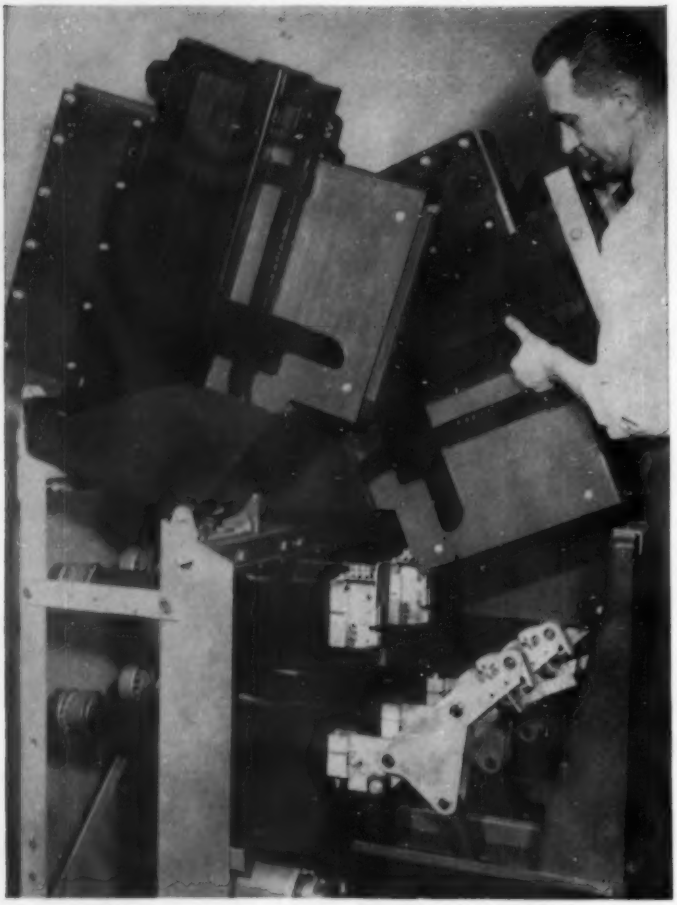
What does this mean to you? It means that if you, too, require water of high quality, from a beaker-full to millions of gallons, for research work or for high-pressure boilers, for steam irons or for industrial processing, you can count on MONOBED ion exchange resins.

Suppose you don't need the ultimate in ion-free water? Then AMBERLITE® ion exchange resins in conventional deionization units may be the answer. AMBERLITE exchangers may be indicated when you want to soften, dealkalize, or deacidify water—when you want to replace or remove ions in solution . . . economically . . . efficiently.

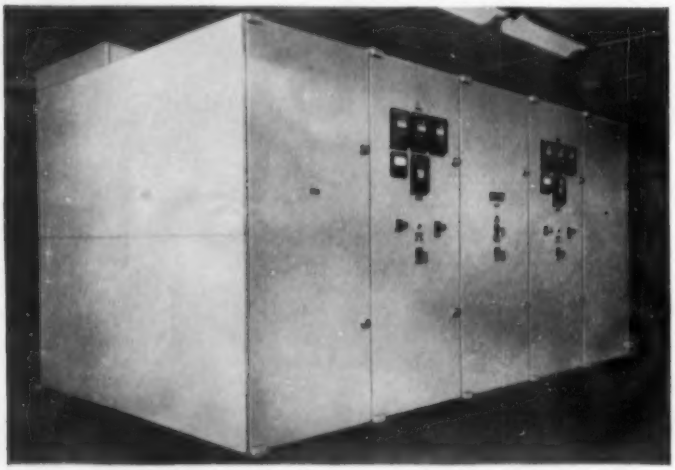
Ask for "If You Use Water . . .", a 24-page booklet of basic information on the ion exchange treatment of water.

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION, PHILADELPHIA 5, PENNSYLVANIA



No cranes are required. Arc chutes pivot. Rest on fixed stop. Illustration shows 15 kv magnetic air circuit breaker.



I-T-E Switchgear in 15 kv rating. All I-T-E circuit breakers are horizontal drawout, interchangeable in like ratings.

TILTING ARC CHUTES

New I-T-E development for 15 kv air circuit breakers

The saving of time and effort which the new I-T-E tilting arc chutes make possible can best be appreciated by anybody who has ever removed the other kind. When inspection time comes, there's no crane lifting of heavy assemblies, no danger of dropping and damaging valuable parts. The arc chutes pivot back safely out of the way for easy inspection of contacts and arc plates. Only I-T-E makes magnetic air circuit breakers with this convenient, modern feature.

I-T-E Metal-Clad Switchgear is made in three basic ratings (5 kv, 7.5 kv and 15 kv), and will interrupt through 500,000 kva. Throughout the line, time-proved features add extra value. Circuit breakers are jig fitted to enclosures. Welded, rigid frames and housings can be lifted as a unit without losing alignment. Complete isolation of compartments insures safety and continuity of service.

Take advantage of I-T-E planning and engineering assistance when you order switchgear. It assures you protection with economy, plus better performance. For details, contact the I-T-E field office nearest you—look in your classified directory under "Electric Equipment." Or write for Bulletin 7004C. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY Switchgear Division

I-T-E

the seal of quality in water tube boilers...

ESTABLISHED 1864

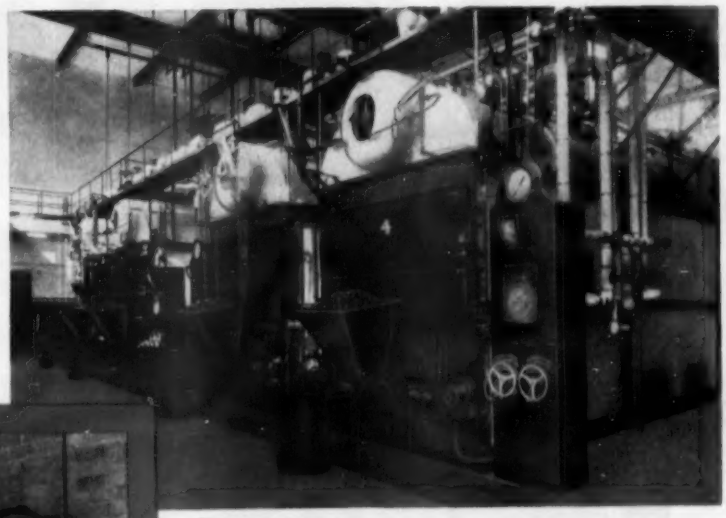
KEELER

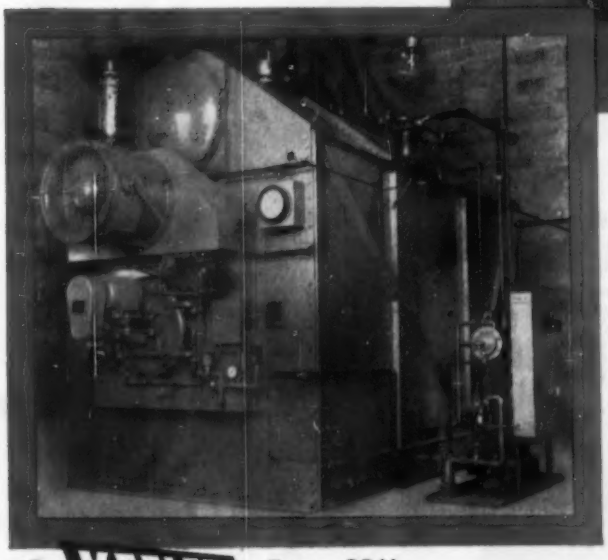
WATER TUBE

PACKAGE STEAM GENERATORS

Original of their type...Recognized Quality

Twenty years ago, the Keeler CP Steam Generator introduced what we know today as "Package Boilers", with the incorporation of furnace water wall design in a package unit for both large and small boiler users. Prior to 1935, this principle was uncommon except in large high pressure installations in utilities and larger industries. The CP became a pacesetter with its large power plant resources in package form by providing a reliable, efficient source of low cost steam for power, process and heat requirements in thousands of operations throughout the nation and abroad.





KEELER Type CPM

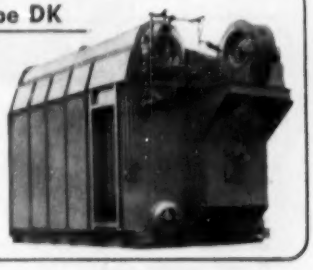
A modification of the CP for gaseous fuels use. An economical forced draft, pressurized furnace unit complete with burning equipment and accessories attached. Pressures to 325 psi, steam capacities to 34,000-lbs. per hour.

KEELER Type CP

Original of the package steam generators, the CP delivers high efficiency with any method of firing (induced, natural or forced draft). Available for all types of fuel and readily convertible at minimum cost. Operates at high overloads without disturbing water level. More steam capacity in a given space and larger combustion chamber with less head room than any other type. Made in a wide range of sizes, in pressures to 500 psi with capacities to 150,000-lbs. of steam per hour.

KEELER Type DK

Newest package unit in the Keeler line—a new, compact, low cost package unit (oil or gas fired) for small space requirements. Pressures to 325 psi, steam capacities to 45,000-lbs. per hour.



Write For Bulletins

No. F-14: Type CP Package Boilers
No. M-2A: Type CPM Package Boilers
No. DK-1: Type DK Package Boilers

KEELER WATER TUBE Boilers

E. KEELER CO.

200-300 West St. • WILLIAMSPORT, PA.

— OFFICES IN PRINCIPAL CITIES —

For wider adaptation . . . and unmatched Service Life . . . . .

Vogt GENERAL GP PURPOSE* DROP FORGED VALVES

We invite you to inquire into the savings which the new line of Vogt GP Drop Forged Steel Valves can make possible in your operations. Not only do their many unique and exclusive features make them more economical of operation, but their broad adaptability to so many industrial applications permits a substantial reduction in operating overhead. Service life, too, is enhanced with Stellite faced seating surfaces which are available at no extra cost along with many other trims.

FREE
Supplement No. 1 to Vogt Catalog F-9

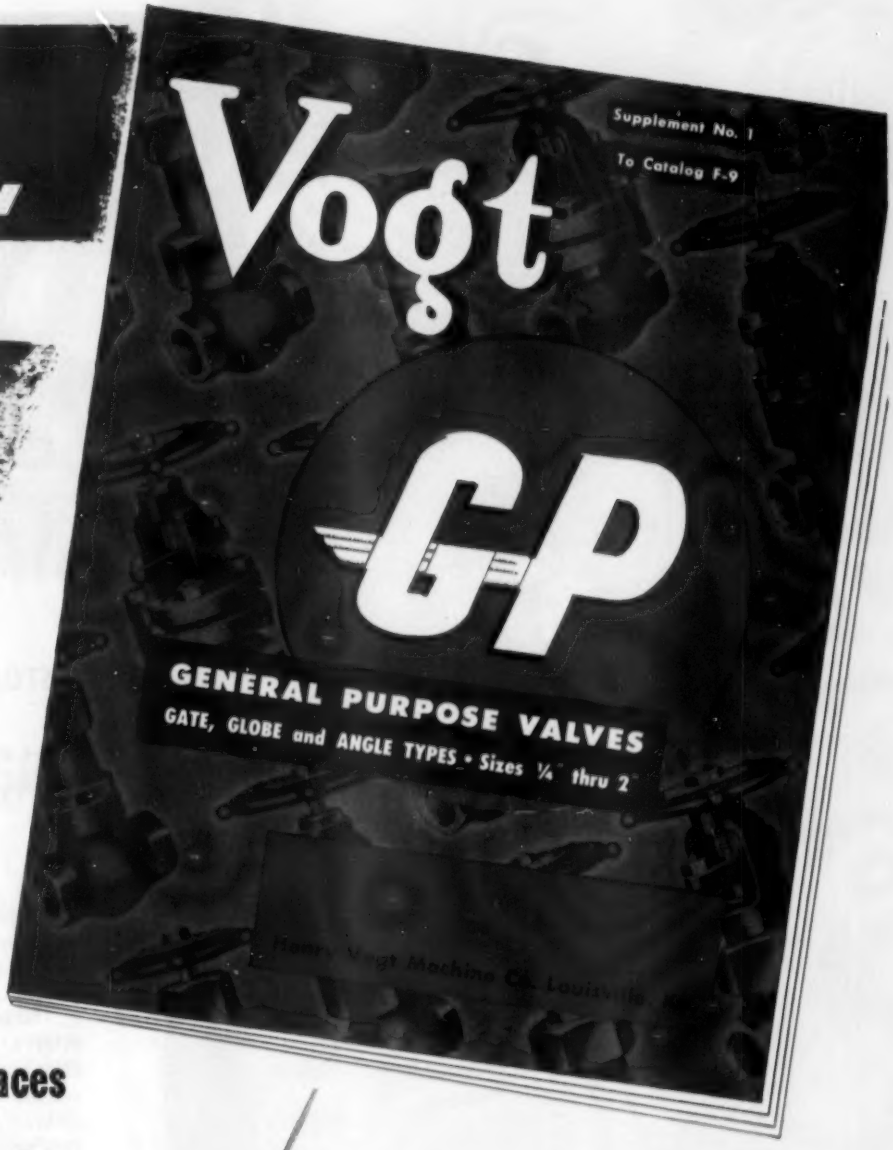
* GP Valves completely fill the demands of industry for a line of compact, lighter weight, shorter face-to-face valves.

Still retaining the safety and ruggedness inherent in a wrought material, these new forged steel screw and socket weld end valves, in sizes from ¼" through 2", are rated 800 pounds at 850°F. and 2,000 pounds at 100°F.

the New

STEEL

ES



150-800 Pounds Service
(2000 pounds cold)

•

Featuring Stellite Faced Seating Surfaces

•

Sizes ¼" to 2"

This 32-page catalog illustrates and gives complete specifications on 11 types of the new Vogt GP forged steel gate, globe and angle valves. Send for your free copy — for ready reference in purchasing. Use the coupon for convenience.

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KENTUCKY

SALES OFFICES: New York, Philadelphia, Cleveland, Chicago, St. Louis, Charleston, W. Va., Cincinnati, Dallas, San Francisco

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY. DEPT. 24-FP

Gentlemen:

Please send copy of New Vogt Catalog Supplement No. 1 to . . .

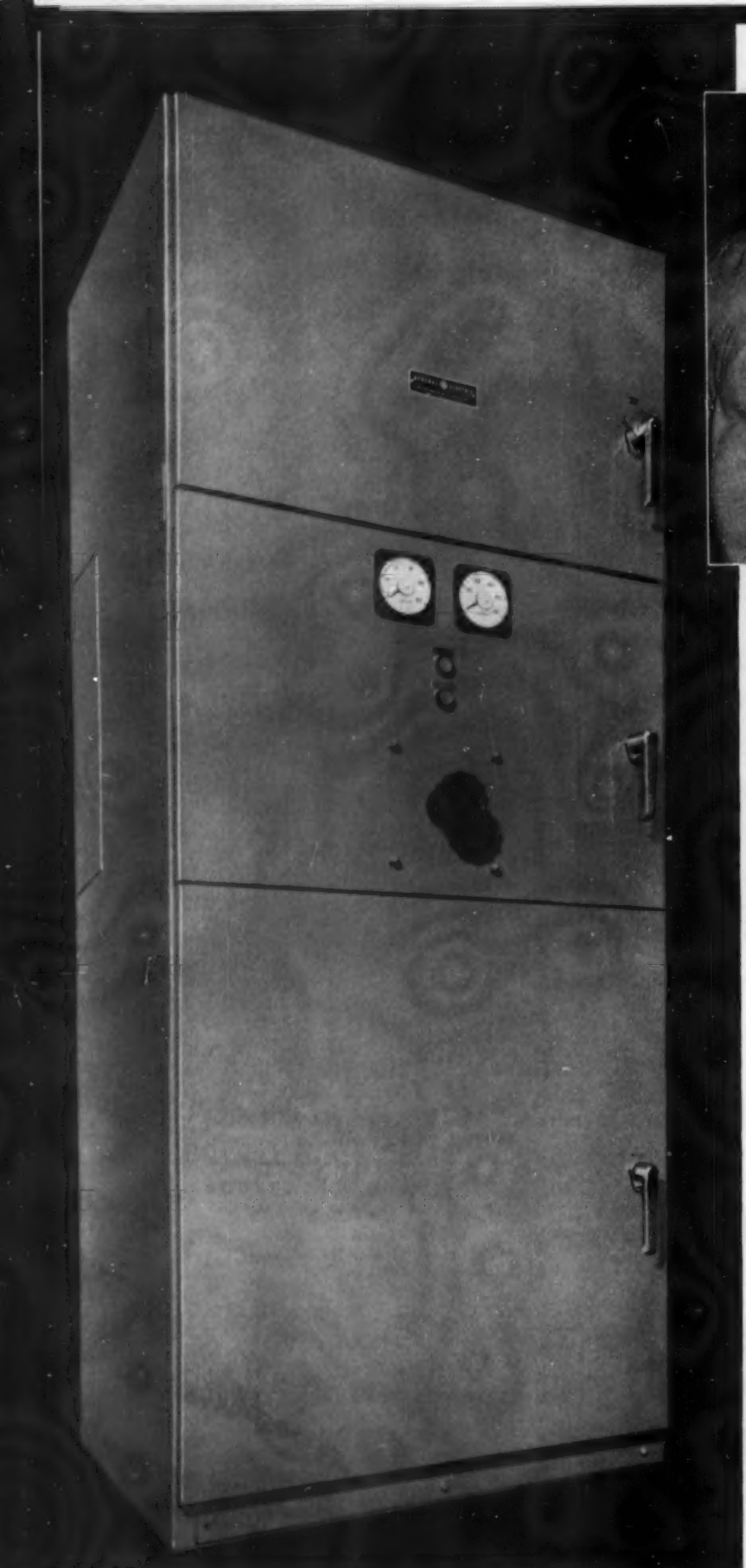
Name_____

Position_____

Firm_____

Address_____

City_____ State_____



3 CUSTOMERS STATE . . .

Space, Safety

Placed on the market in July of this year, General Electric's all-new Limitamp Control has received enthusiastic acceptance throughout industry.

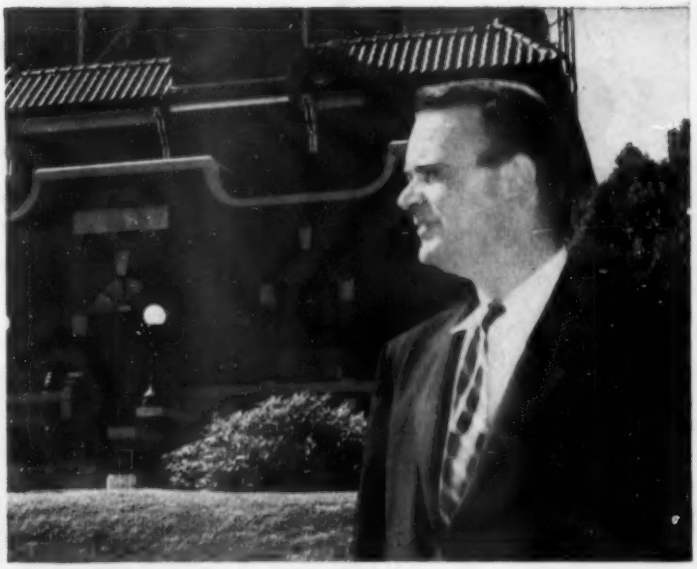
1. NEW MOUNTING ARRANGEMENTS. Almost immediately, L. L. Hamig, of Ferris & Hamig, Consulting Engineers, found the exclusive front-connected feature of the new control solved a tough application problem. There is no need for a back aisle with the new equipment, so units may be mounted back-to-back, back-to-wall, or as free standing enclosures yielding great space savings.

2. 50% SMALLER. In another case, H. A. Weigand, of Ingersoll Rand Company specified this new fused starter in a compressor station for the Laclede Gas Company of St. Louis, Missouri. Mr. Weigand stated the new control's 50% floor space saving feature simpli-

50% smaller than previous models, all-new G-E Limitamp Control offers a gang-operated disconnect switch as standard equipment. See opposite page for space savings comparisons.

"The all front-connected feature of G.E.'s Limitamp Control gave me the versatile floor arrangement I needed to solve a tough application problem," said Mr. L. L. Hamig (extreme left) of Ferris & Hamig, Consulting Engineers, St. Louis, Mo. Seated are R. E. Watts of Ferris & Hamig and P. L. Korklan, General Electric Co. Sales Engineer.

"The space savings offered by G.E.'s Limitamp Control helped simplify the installation of a compressor station for the Laclede Gas Co. of St. Louis," according to H. A. Weigand of Ingersoll Rand Company. The compressor station is located in a residential area and conforms to local building codes. This put space requirements at a premium and posed a real installation problem.



Problems Solved by New G-E Limitamp* Control

fied installation where space considerations were a primary factor.

3. ADDED SAFETY. One of the nation's largest automobile manufacturers ordered eight of the starters and within days increased the order to 17. The gang-operated disconnect switch and co-ordination features which afford greater protection of the starter, the controlled equipment, and personnel were exactly what they wanted.

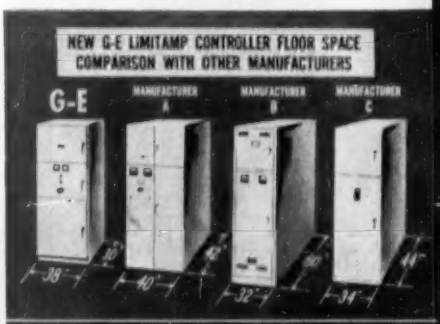
The 30" depth of the new Limitamp Control, which allows the unit to be transported through normal size doorways, has also received industry-wide approval. The unit's 90" height includes bus compartment which is surrounded by steel barriers within the enclosure.

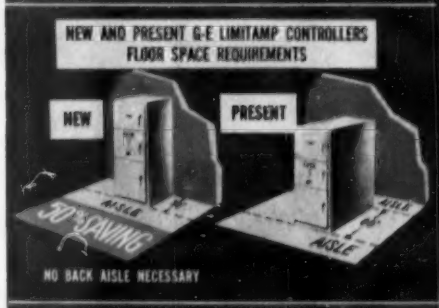
Other features which save time and money on installation and maintenance are the low-voltage panel, hinged to swing out of the cabinet, and the contactor which may be easily rolled in or out of the enclosure. This provides ample room for a worker to enter the enclosure while making installation connections.

This all-new Limitamp Control is ideal for high-voltage motors, rated 2300-4800 volts, up to 3000 hp, and may be applied to squirrel-cage, synchronous, wound-rotor, and multi-speed motors on power systems requiring high interrupting capacity for maximum short-circuit protection.

Specify the all-new Limitamp Control through your nearest G-E Apparatus Sales Office. G-E engineers will help apply this new control to your operation. For more information write for Bulletins GEA-6331, GED-2446, to Section 781-14, General Electric Company, Schenectady 5, New York.

*Trade-mark of General Electric Co





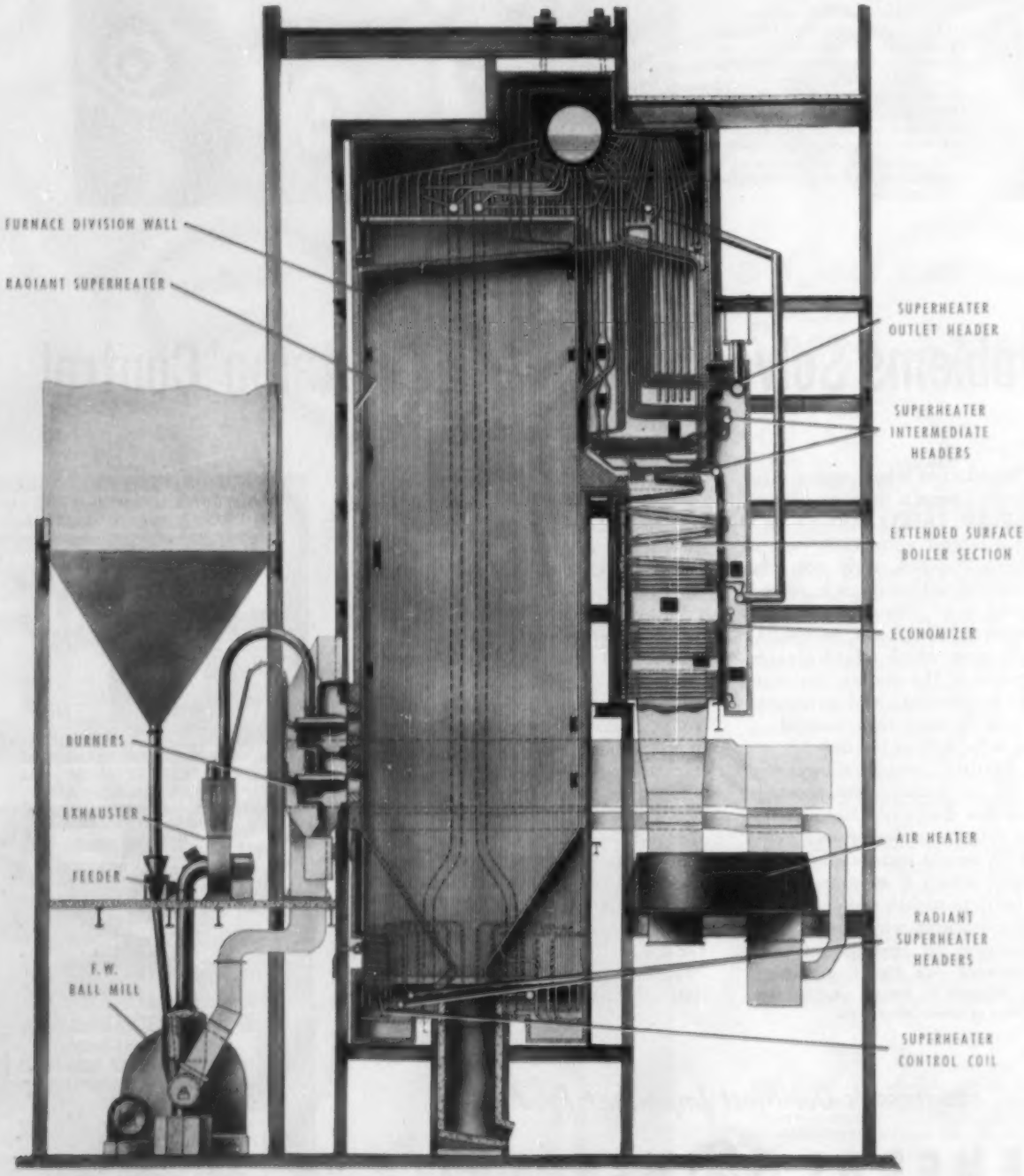
NEW G-E LIMITAMP CONTROLLER OFFERS VERSATILE FLOOR ARRANGEMENTS
BACK-TO-BACK CENTER AISLE MOUNTING
BACK-TO-WALL MOUNTING

Progress Is Our Most Important Product

GENERAL ELECTRIC

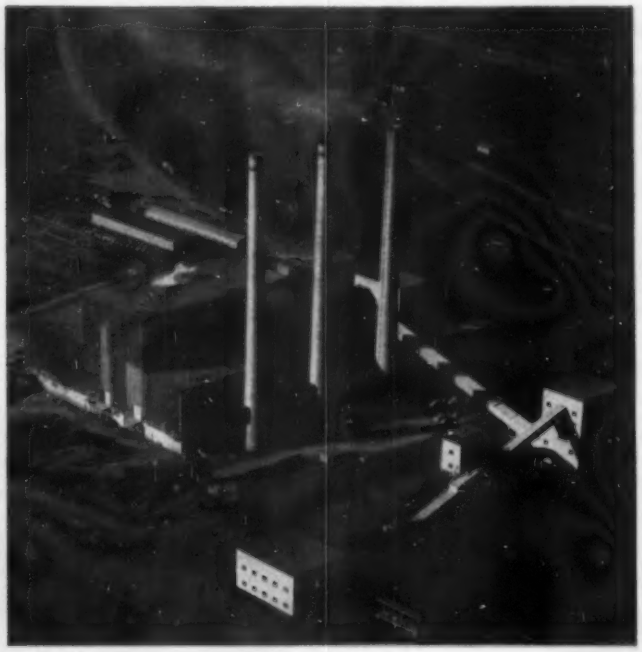
large mid-western utility

8th — FW STEAM



installs

GENERATOR



New Foster Wheeler Unit supplies 860,000 lb/hr at 1700 psig for 100,000-kw turbo-generator ... brings total capacity on this one system to 2,145,000 pounds per hour!

Latest addition to the modern steam plant shown above is a new 100,000 kw turbo generating unit. It is served by the Foster Wheeler unit shown in section at the left, which generates 860,000 pounds of steam per hour, at 1700 psig pressure and a temperature of 1000 F.

This installation marks the *eighth* large Foster Wheeler steam generator now "on line" in the various stations of this *one* utility system. Among the features of this unit are the FW combination radiant and convection superheaters, new horizontal steam separators, the reliable FW ball mill pulverizer system and the improved inter-vane burners.

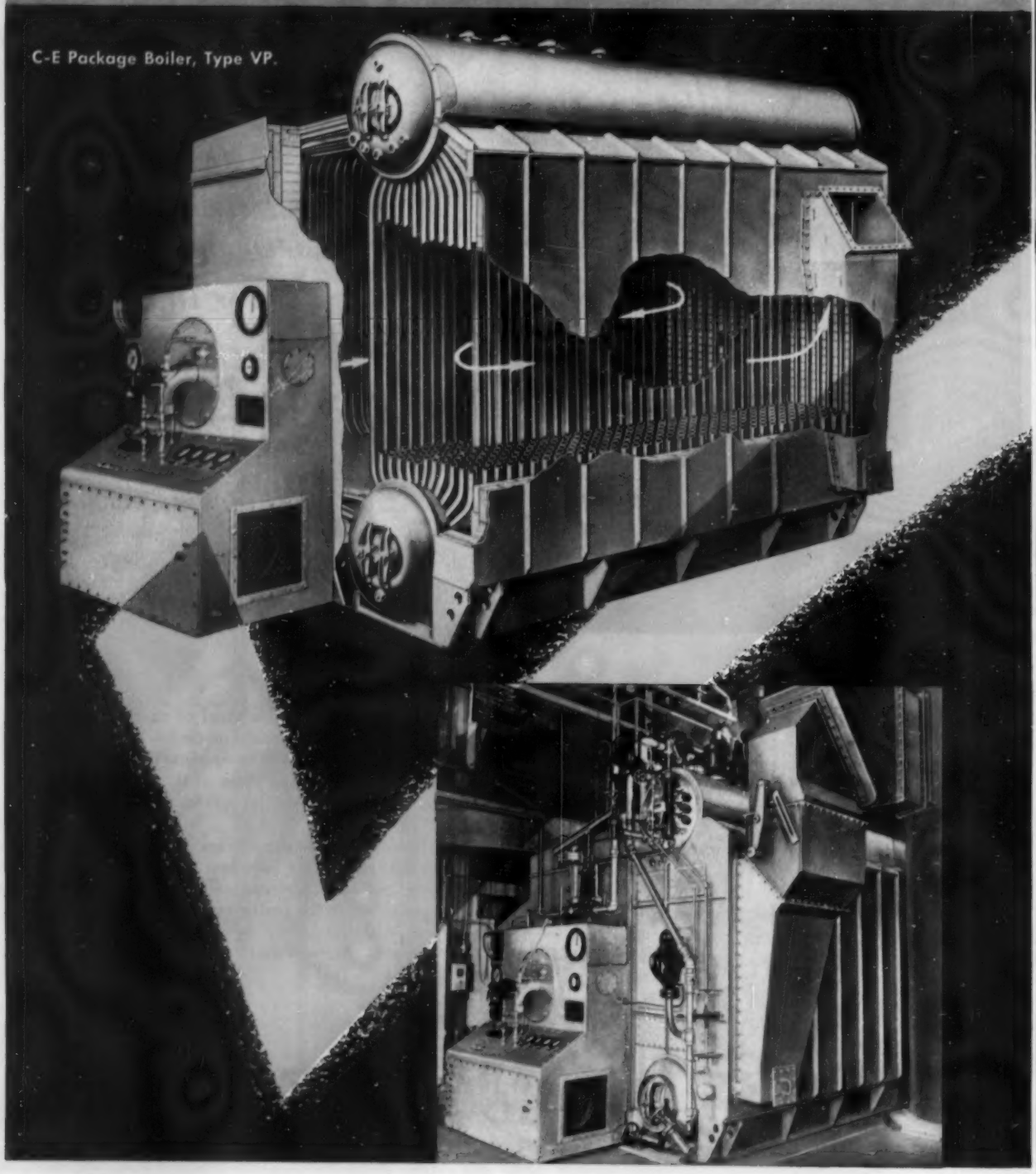
Here we have positive proof of customer satisfaction — based on years of actual on-the-job performance with previously installed FW equipment. That means satisfaction that covers every phase of the job, from planning and erection to successful operation and servicing.

Repeat orders like this, from leading utilities throughout the country, are your best assurance of trouble-free steam generator performance. Whatever your pressure, capacity or steam purity requirements, you can meet them *with confidence* by specifying Foster Wheeler equipment. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

BEFORE YOU BUY A PACKAGE BOILER . . .



C-E Package Boiler, Type VP.

CHECK THIS LIST!

	BOILER A		B		C	
	Yes	No	Yes	No	Yes	No
Will your boiler be a real "package" type with control panel and all controls mounted integral with the boiler?	☐	☐	☐	☐	☐	☐
Will your package boiler be equipped with drum internals to assure dry steam?	☐	☐	☐	☐	☐	☐
Will its "steam quality" be backed with a guarantee?	☐	☐	☐	☐	☐	☐
Will your boiler have a 30-in. lower drum to provide convenient accessibility?	☐	☐	☐	☐	☐	☐
Will yours be a one-burner boiler, with a simple wiring and control system?	☐	☐	☐	☐	☐	☐
Will your boiler have the largest load swing range available?	☐	☐	☐	☐	☐	☐
Will your boiler be equipped with a quiet centrifugal fan?	☐	☐	☐	☐	☐	☐
Will your furnace be *completely* water-cooled?	☐	☐	☐	☐	☐	☐
Will your furnace have the highest ratio of water cooled surface to furnace volume?	☐	☐	☐	☐	☐	☐

If you are in the market for a package boiler, this check list can provide you with some interesting answers. Of course C-E's Type VP Boiler rates a "yes" answer to every question. In addition it offers many other operational advantages such as simple, effective soot blowing; high heat absorption; low draft loss; no dead gas pockets and simple baffle arrangements.

Little wonder then that VP purchasers range from small companies to some of the largest in the country . . . industrials of all kinds . . . schools and institutions . . . various government agencies . . . including the Atomic Energy Commission. These users are employing VP Boilers for all types of applications — heating, process, and even power generation.

SPECIFICATIONS
of the VP Boiler

Capacity — 4,000 to 40,000 pounds of steam per hour

Pressures — up to 500 pounds per square inch

Fuel — oil or gas

Erection — completely shop-assembled

Foundation — simple concrete slab

Make sure that you have details of the VP at your fingertips when you are in the market for a boiler of moderate capacity. Ask for the new Catalog VP-108, which contains specifications and general information on dimensions, construction details and controls. B-845

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

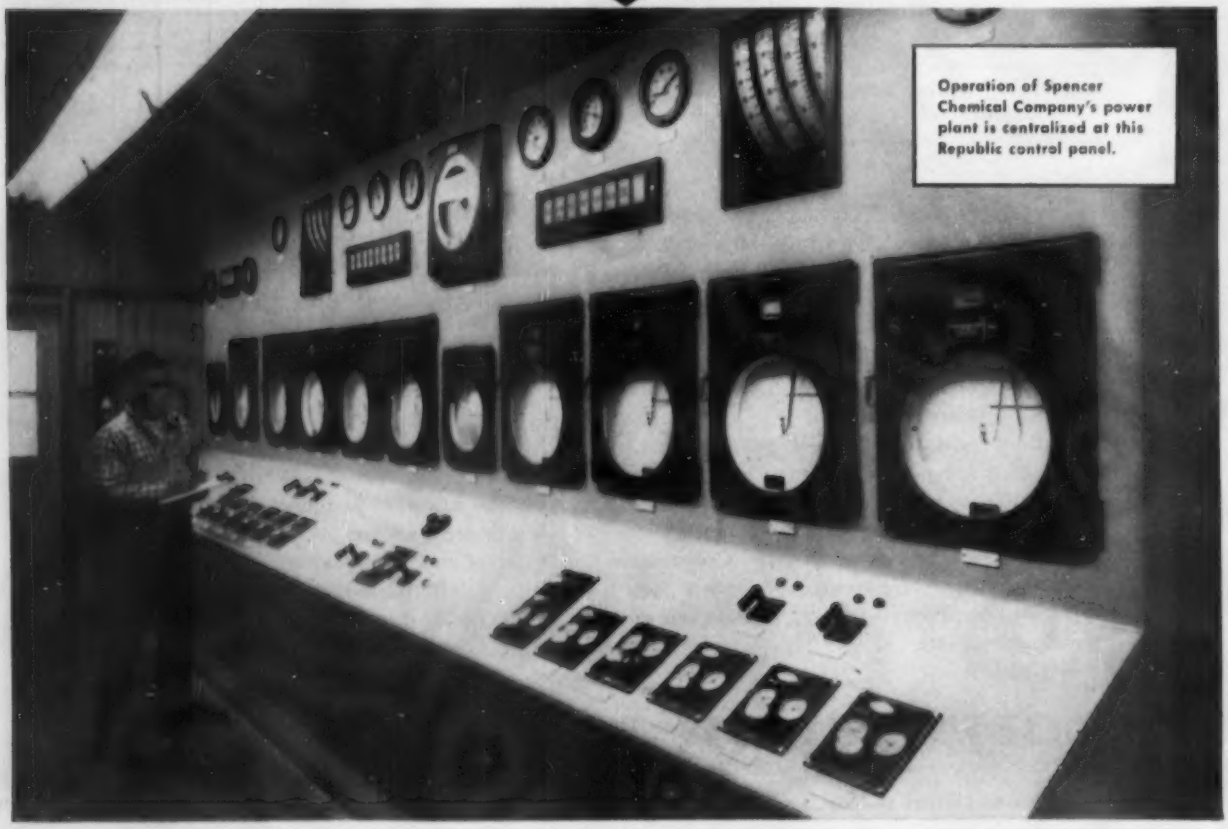
Automatically Controls Outdoor Steam Plant

FOR FAST LOAD CHANGES

REPUBLIC Combustion Control System at New Texas Chemical Plant Automatically Prevents Flame-Outs and Over-Firing on Wide Load Swings, Enables Boilers to Meet Sudden Steam Demands Smoothly and Safely

Extremely large and fast load changes make combustion efficiency only part of the combustion control job at Spencer Chemical Company's new Orange Texas polyethylene plant. The control system operates two gas fired 60,000 lbs. per hour boilers in the plant for fast response to load changes without over-firing or losing ignition on wide load swings.

To prevent over-firing when there is a sudden demand for more steam, a gas



Operation of Spencer Chemical Company's power plant is centralized at this Republic control panel.

safety regulator keeps the fuel valve in step as draft fans increase speed. By compensating for the unequal speed of response of the two boiler auxiliaries, the control system maintains proper conditions *even while loads are changing.* If steam demand falls below minimum steam conditions, a minimum gas pressure is maintained automatically at the burners, regardless of the number in service, to prevent flame-outs. In addition to safer operation, these features also mean continuous combustion efficiency for extra fuel savings.

When your problem is combustion control—for a small power plant or a central station—it will pay you to contact Republic. At your service is an experienced engineering staff that can design the control system that exactly meets your needs—specialized as they may be. This combination of expert design and modern Republic equipment can assure you of dependable, efficient control of your power plant.

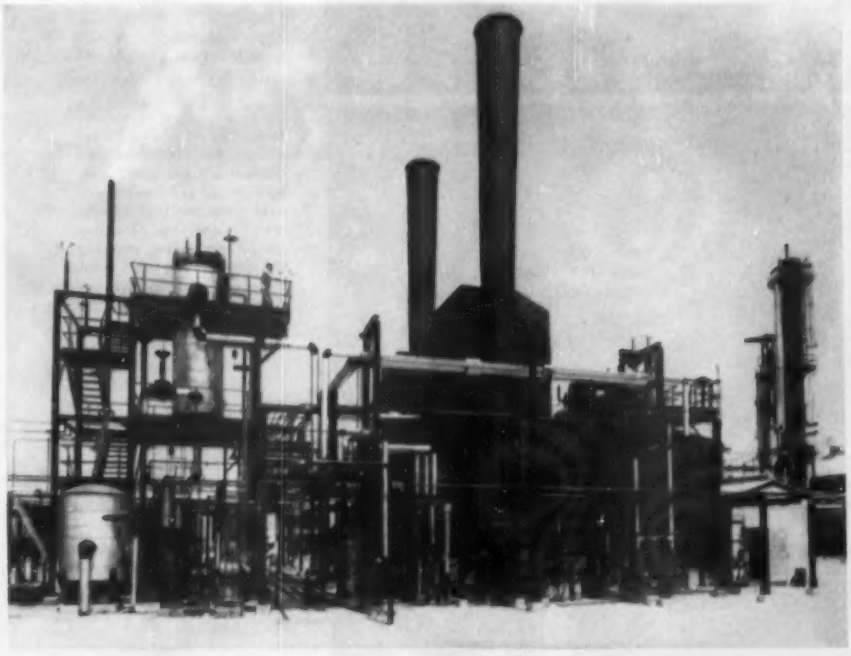
REPUBLIC

Automatic COMBUSTION CONTROLS

(pneumatic or electronic)

- ★ **FOR ALL SIZES AND TYPES OF BOILERS**
- ★ **FOR ALL LOAD CONDITIONS**
- ★ **FOR ALL METHODS OF FUEL FIRING**
- ★ **FOR ANY ARRANGEMENT OF DRAFT**

Write for details



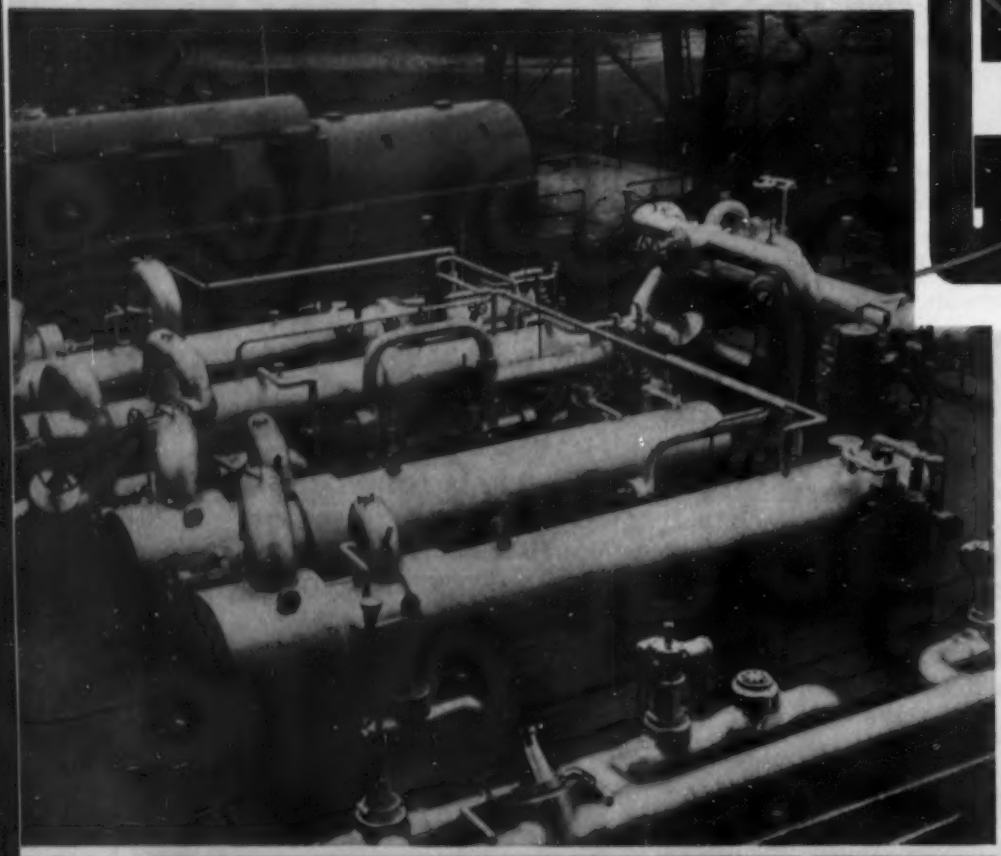
THE ENTIRE POWER PLANT,

except for the control panel is outdoors. Panel board is housed in sheet metal building at right. The two 60,000 lbs. per hour gas fired boilers, operating at 415 psi and 750°F., furnish steam to compressors used in converting ethylene gas into polyethylene. This is new miracle plastic that is used for products ranging from "squeeze" bottles to electrical insulation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

GPE.....



Griscom-Russell feed water heaters in a 125,000 KW public-utility power station; save nearly 100 tons of coal per day. Heaters handle flow of water exceeding 2000 G.P.M. at 2500 pounds pressure and steam extracted from the turbine at five different points; "train" of five units preheats water fed to boilers from 90° F. to 441° F.

Askania multiple fuel boiler control panel in large steel plant; maintains metered proportion between combustion air and fuels—coke oven gas and fuel oil—for most economical combustion; holds steam pressure constant through all load changes and keeps furnace pressure at a safe and predetermined value.

General Precision Laboratory's Industrial TV Camera, the "Bullet"; portable, easily operated; used to monitor and improve manufacturing processes and to view hazardous industrial operations.

The highly advanced technological products designed and manufactured by the eighteen producing companies of General Precision Equipment Corporation serve more than a dozen major industries. Products of six of these GPE Companies—Griscom-Russell, Askania, Librascope, Link, Kearfott and General Precision Laboratory—have widespread application in the processing and power industries.

Industrial Processing...and Power

The Griscom-Russell Company is one of the country's largest producers in the fields of heat exchange and water distillation. It is the pioneer in heat exchanger equipment—the key to the whole complex of modern industrial processing and power. For over seventy years, G-R equipment has been responsible for greatly increased efficiency and lowered operating costs in industry.

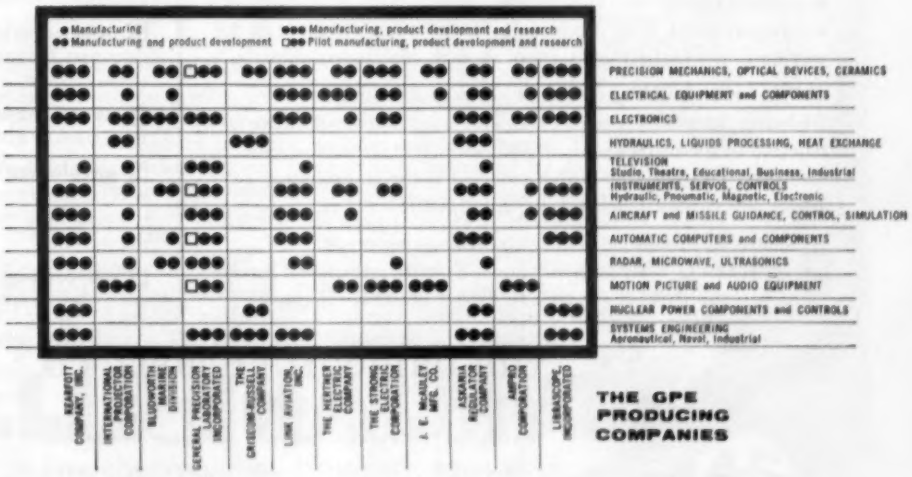
Askania Regulator Company for a quarter of a century has been a leading developer in the field of regulators and controls, including components and systems. Its products are widely used by the power, steel, gas and coke, mining, chemical, petroleum, glass and paper industries—wherever great reliability and accuracy are essential.

Kearfott Company, Inc.; Librascope, Incorporated; and Link Aviation, Inc. produce a wide variety of precision instruments, computers, servos and other control components for equipment and systems used throughout the power and the processing industries. Industrial television equipment manufactured by General Precision Laboratory Incorporated, the sixth GPE Company active in these fields, is playing increasingly important roles in "seeing eye" monitoring operations in these industries.

Each company in the GPE Group works in specific, highly specialized technical areas, as indicated in the chart below. Each of these companies, in addition to specializing in its particular products and fields of technical competence, has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation is achieved through GPE's basic operating policy, Coordinated Precision Technology.

In the fields of research and development, GPE Coordinated Precision Technology permits a high degree of specialization in particular areas of competence and supplements such specialization by the application of techniques in other fields, as desirable. In the field of production, it makes possible a highly flexible application of facilities. This policy has been responsible for a diversified line of precision equipment of superior design and performance, covering a wide range of both standard and special uses.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment, and of solutions to the underlying technical problems, are not restricted or distorted by traditional allegiance to specialization in a particular field. GPE coordination permits the engineers and technical personnel of each GPE Company to seek the optimum solution for the customer within the total capacities of the GPE Companies as a group.



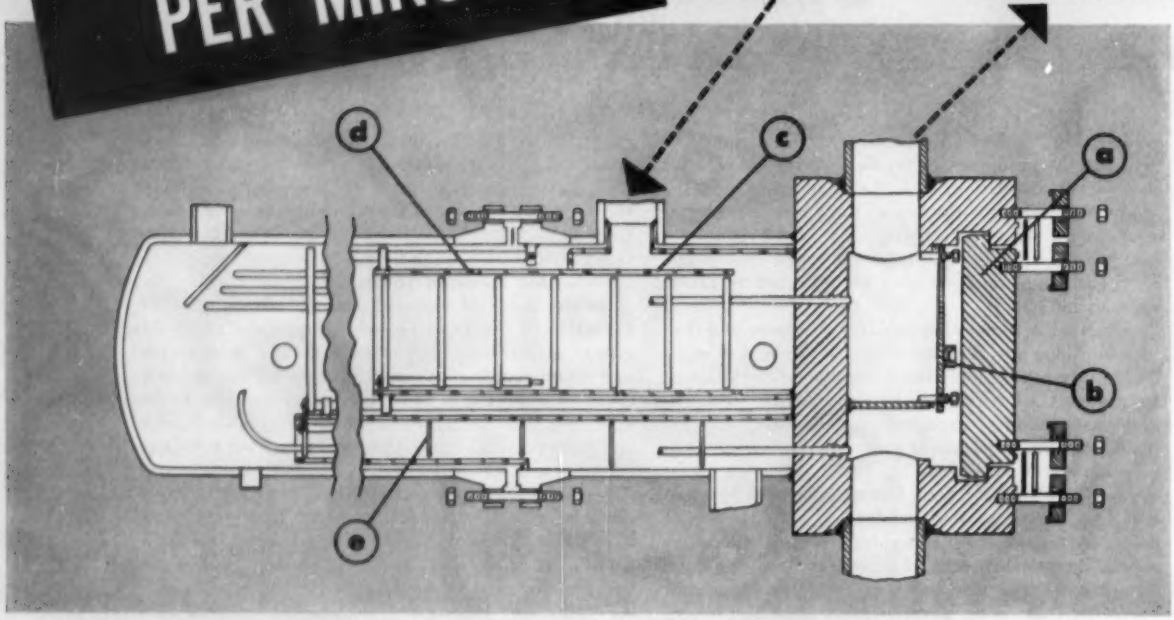
A brochure relative to GPE Coordinated Precision Technology and the work of the GPE Companies is available. Address your request, or inquiries on specific problems, to:

General Precision Equipment Corporation

92 GOLD STREET, NEW YORK 38, NEW YORK

A MILLION BTU'S PER MINUTE

transferred from steam to water



That's the rate at which many hundreds of G-R Feedwater Heaters are preheating the boiler feed for large central power stations.

Many of these G-R units have, in fact, far greater capacity . . . and on the other hand, G-R Feedwater Heaters are also available for the lower capacities required by smaller industrial plants.

In pressure ratings, too, G-R Feedwater Heaters can be furnished for any requirements, from moderate industrial plant pressures all the way up to the highest pressures of modern central station practice.

G-R has been building feedwater heaters for as long as feedwater heaters have been used. This unequalled experience is reflected in the many exclusive and distinctive features of G-R Feedwater Heaters. It is further reflected in the authoritative advice and ratings which you depend upon from G-R.

No matter what may be your feedwater heating needs, get the benefit of G-R recommendations. You are *sure* of best results when you specify G-R for your feedwater heater requirements.

The sectional view of the high-pressure condensing, sub-cooling and desuperheating feedwater heater illustrated above shows some of the many exclusive G-R features:

a "breech-block" water head cover... gasketed joint accessible for inspection and adjustment without removing the cover.

b pass partition plate . . . makes use of inter-pass pressure differential to prevent internal leakage.

c steam impact baffle . . . protects tubes from erosion due to entering steam.

d enveloping steam baffle . . . permits heating the water above the dry and saturated temperature using the available superheat in the steam.

e sub-cooling zone . . . for sub-cooling the drains before leaving the heater shell.

THE GRISCOM-RUSSELL CO.

MASSILLON, OHIO

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

G-R HEAT TRANSFER APPARATUS

Feedwater Heaters

GR321

How Zeolite System at Public Service Company of Colorado

"Irons Out"

Water Irregularities Caused by Fluctuating Loads

DENVER'S UNUSUAL CLIMATE causes unusual water conditioning problems at Public Service Company of Colorado's Zuni Station. Steam from this station is used to heat downtown Denver buildings. Denver's balmy midday climate — except in the two cold months of the year—is the cause of troublesome load fluctuations.

The lime-soda-phosphate system installed in this plant by Allis-Chalmers in 1949 was one of the most modern in the country at the time. It is ideal for extremely high loads in the morning and evening, but requires careful adjustment to handle the low loads around noon.

Public Service of Colorado has decided to modernize to take advantage of developments in "hot lime–hot zeolite" systems since the original installation. The zeolite part of the system acts as its own corrective when loads drop, "ironing out" hardness irregularities in the lime effluent and eliminating need for manual adjustments. The new system will provide more consistent operation and lower hardness. The only chemicals needed are lime and salt, holding operating costs to a minimum.

The changeover, being handled completely by Allis-Chalmers, consists of adding zeolite softeners to the original equipment furnished by A-C.

Next time you have a water problem — or want to consider modernization — take advantage of Allis-Chalmers water conditioning experience. For information, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

A-4846

American Coal Crushers

with PATENTED SHREDDER RING REDUCTION PRINCIPLE . . .

GIVES BETTER COAL PREPARATION BECAUSE . . .

. . . it reduces coal by SPLITTING instead of CRUSHING

RESULT:

CONTROLLED UNIFORMITY

In operation, American's exclusive shredder rings swing outward, by centrifugal force, on their shafts —and reduce coal by the splitting action of 20 cutting edges on each shredder ring.

This action produces less fines, a more uniform product. The rings are reversible for double life.

and for
LOW-COST COAL SAMPLE CRUSHING . . .

The American Sample Crusher, with its new adjustable sampling hopper, gives 5%, 10%, 15% or 20% of a sample . . . in one operation.

WANT MORE INFORMATION?

There are many *other* design and performance advantages in American Rolling Ring Coal Crushers—features that mean bigger tonnage figures, and lower maintenance (as proved repeatedly by coast-to-coast operations records). WRITE today for Bulletin AC, and get the crushing facts!

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

FELT PRODUCTS MANUFACTURING COMPANY

Skokie, Ill.
Aug. 15, 1955

McDonnell & Miller, Inc.
3500 N. Spaulding Ave.
Chicago 18, Ill.

Attention: Mr. Fred Rohe

Dear Mr. Rohe:

We are highly pleased with the positive operation of your McDonnell No. 92 Hi-Pressure Controller on our Mears-Kane-O'Feldt Boiler.

As you know, the continuous operation of this boiler is vital to our manufacturing operations as the live steam from it, up to 200 psi., is used to heat molds for pressing gaskets which we make.

Your controller appears to be all that can be asked for in quality and advanced design. We believe it is as fool proof and service free as a piece of equipment can be.

We also appreciate your care in checking our requirements and making sure the controller is correctly installed and giving good service.

Sincerely,

Hiram F. Turner

Hiram F. Turner

No shut-down shudders here!

As the letter opposite makes clear, the McDonnell Pump Control, illustrated below, is handling a mighty important job in the big, modern Skokie plant of Felt Products Mfg. Co.

Its task is to maintain an adequate water level in the fast-steaming Mears-Kane-O'Feldt Boiler on which it is installed. This boiler supplies process steam at pressures up to 200 psi. to molds used for pressing gaskets . . . so a boiler failure could be ruinous to gasket production.

This is the kind of job the new McDonnell No. 92 Pump Control, Low Water Cut-off and Alarm was built to do — the kind of job it is doing supremely well as brought out in the letter from Mr. Turner of Felt Products Mfg. Co.

Never forget that low water strikes its deadly blows without warning. So only the best boiler water level control is good enough to safeguard *your* boiler. In the new McDonnell 92 Series you have the best that care and experience can produce for higher pressure applications like this . . . and there is a McDonnell control for every application and pressure up to 250 psi. Read the facts about the new 92 Series and ask for bulletin L-119 that tells the entire story.

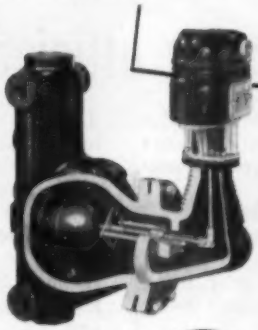
McDONNELL & MILLER, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

New product of "Doing One Thing Well"

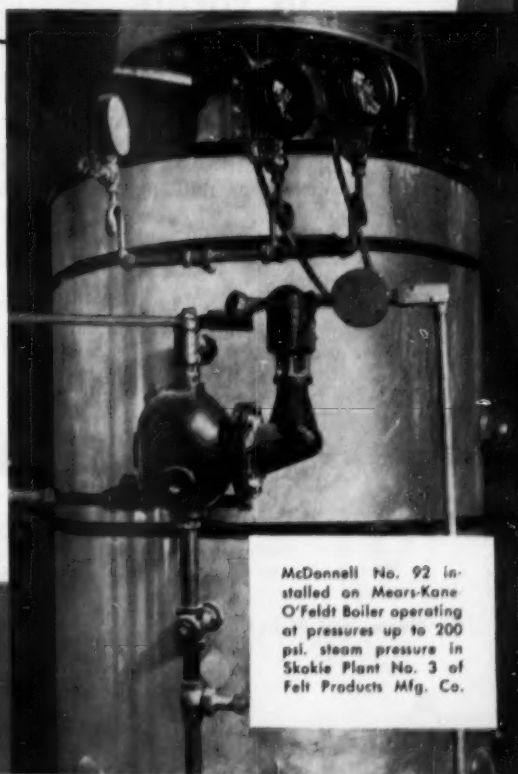
A pump control, low water cut-off and alarm for steam pressures up to 250 lbs.

Out of long experience with Alnico magnets as applied to electrical switches has come a new principle in magnetic switching used for the first time in the McDonnell No. 92 Pump Control, Low Water Fuel Cut-off and Low Water Alarm. Unlike other magnetic switches, those used in the No. 92 series operate on *repulsion — not attraction* — giving a powerful and positive action in both opening and closing.



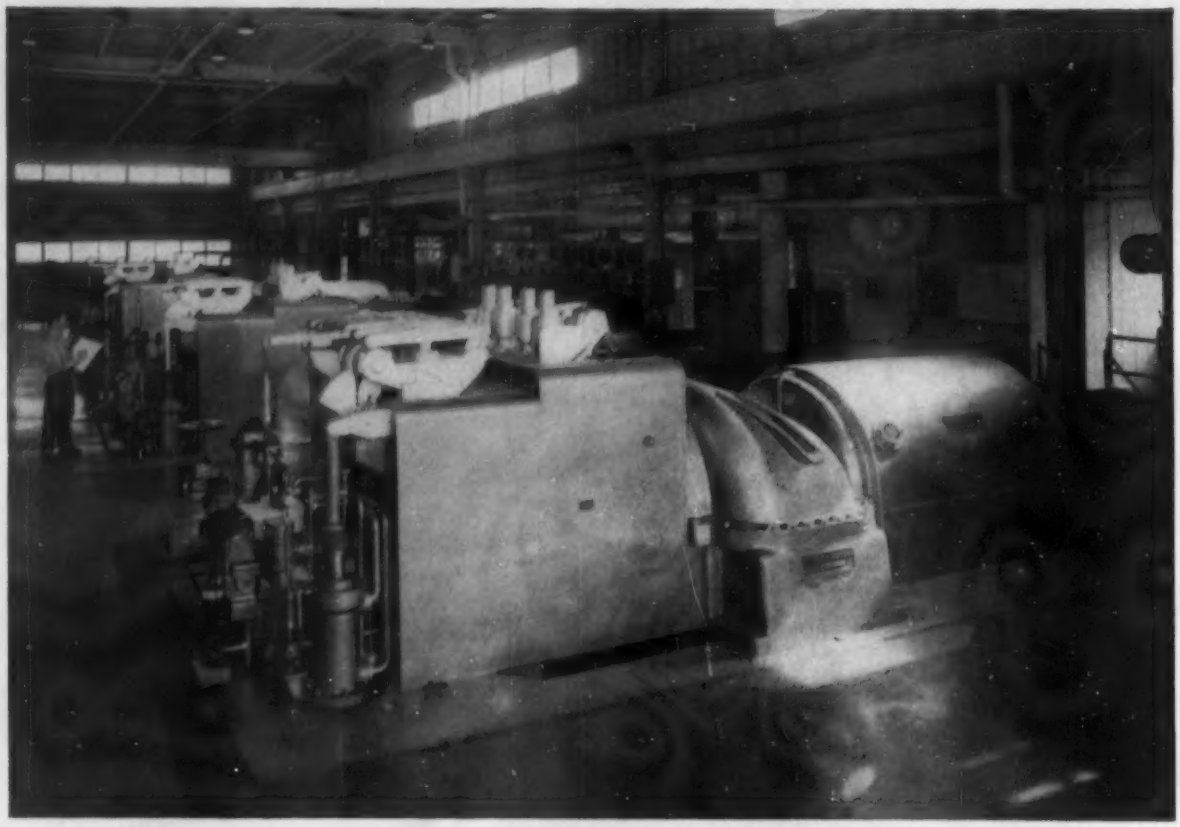
Your Jobber Stocks Them

This new principle is found in a control that has been designed throughout to provide a new measure of dependability. Notice the generous float chamber and deep sediment chamber . . . little possibility of interference with float operation here! Float arm fulcrums on flat Beryllium springs assuring accurate alignment and minimum friction—another advancement. A typical refinement is a "Teflon" sleeve on the coupling to the switch rod. "Teflon" is made to order for this difficult assignment. Remarkable dissipation of heat is accomplished between float chamber and switches. The drop (to 167°F.) complies with *current* Underwriters' standards — a remarkable accomplishment. The control is also made with integral water column (No. 192) which cuts installation costs. Ask for data showing how easily and economically this control can be applied to your boiler.



McDonnell No. 92 installed on Mears-Kane-O'Feldt Boiler operating at pressures up to 200 psi. steam pressure in Skokie Plant No. 3 of Felt Products Mfg. Co.

McDONNELL *Boiler Water Level Controls*



WORTHINGTON TURBINE-GENERATORS, Anchorage, Alaska. These 3000-kw turbine-generators give economical, trouble-free service in one of the few plants in this vicinity.

Why cam-operated nozzle control valves* pay off in turbine-generator efficiency, lower costs

Here are five reasons *all* Worthington multivalve turbine-generators — down to the smallest — are equipped with cam-operated valves for precision nozzle flow control:

1. Individual cams are shaped to give best flow-lift characteristics, resulting in close frequency or speed control.
2. Valves open in sequence, correct overlap being easy to obtain by adjustment, assuring smooth power response.
3. Valve operation can be checked without breaking any steam joint, since mechanism is outside steam chest.
4. Valve operation can be readily adjusted after installation to suit load conditions.
5. No operating oil above the steam chest, eliminating fire hazard.

Another reason for top performance with every Worthington steam turbine-generator is the fact that turbine and generator are designed as a unit. Before shipment both the turbine and the generator are put together in the Worthington factory and tested as *one unit*.

For more facts about Worthington turbine-generators, write to Worthington Corporation, Steam Turbine Division, Section T.5.5, Wellsville, N.Y. T.5.5

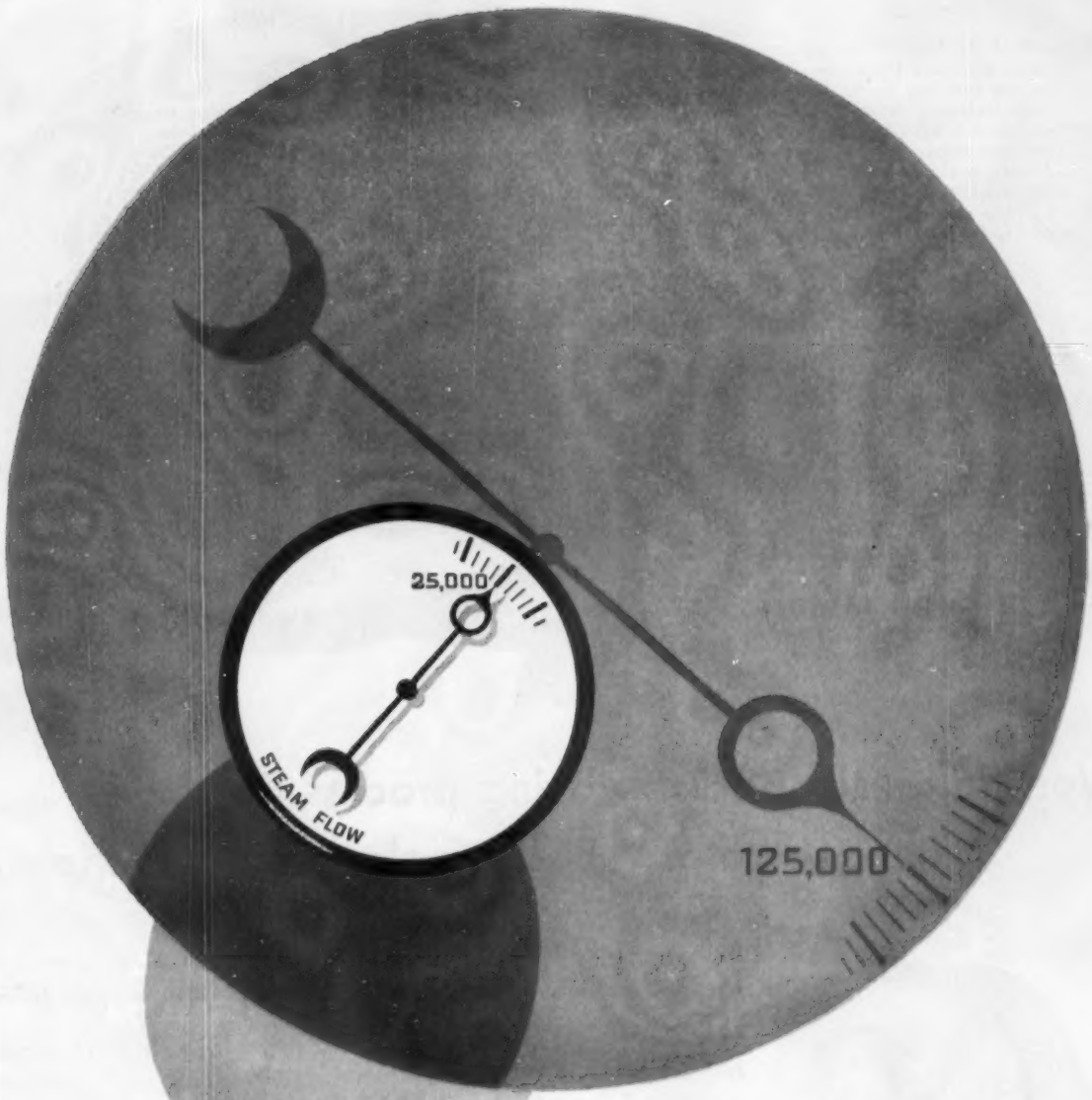
**Standard on all Worthington multivalve turbine-generators*

WORTHINGTON

STEAM TURBINES

Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM



get these 4 Ljungstrom® savings in small boilers...too!

The *completely shop-assembled* Package Ljungstrom Air Preheater brings to boilers as small as 25,000 pounds of steam per hour the four proved advantages of regenerative preheating:

1. Saves fuel. This reduction in fuel consumption can be sizeable . . . and can write off the cost of the unit in about a year. For in most installations yearly fuel costs match the initial cost of the boiler.

2. Boosts boiler output. Preheated air intensifies the combustion process. Heat absorption into boiler tubes increases correspondingly, raising the unit's capacity to produce steam.

3. Increases boiler reliability. Since combustion is more efficient — fuel is burned more completely . . . there's less slagging . . . boilers stay on line longer. What's more, stack gases should be cleaner.

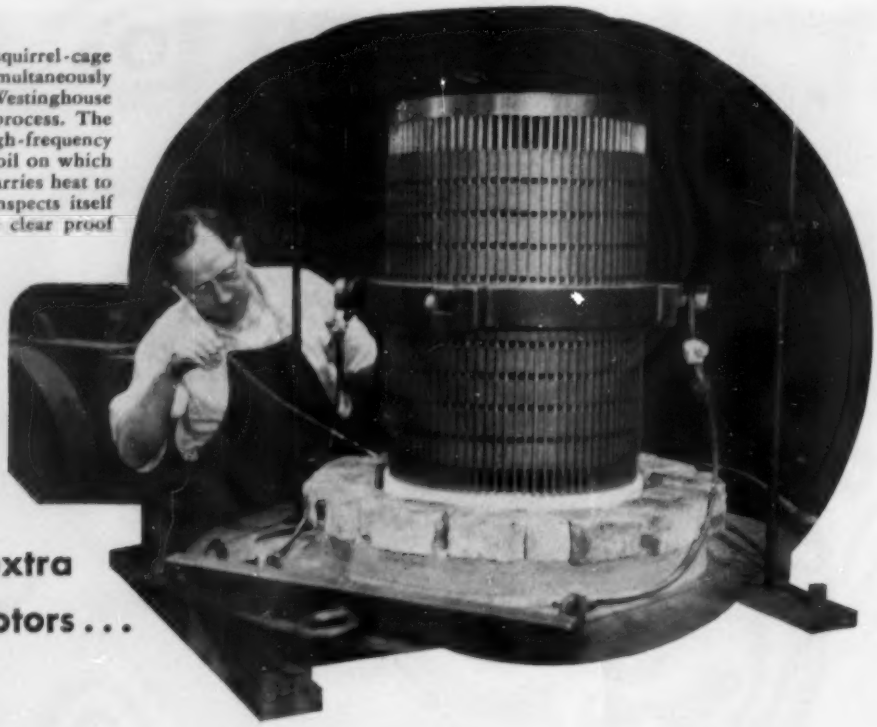
4. Burns lower-grade fuels. Higher furnace temperatures make practical the burning of lignites and similar low-grade fuels.

Find out how the efficient, low-cost Package Ljungstrom Air Preheater can be applied to your steam-generating units. Write, today, to The Air Preheater Corporation.

The Package Ljungstrom operates on the continuous regenerative counter-flow principle. The heat-transfer surfaces on the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming combustion air.

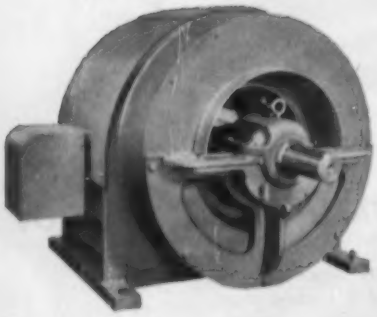
The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

All of the bars of this squirrel-cage rotor are being joined simultaneously to one end ring by the Westinghouse high-frequency brazing process. The end ring is heated by high-frequency currents induced by the coil on which it rests, and conduction carries heat to the bars. This process inspects itself . . . the red-hot bars are clear proof of positive joints.



A big extra in large motors . . .

Westinghouse special brazing process boosts rotor reliability, slashes maintenance



This is a large standard type CSF drip-proof motor. It can easily be modified to meet any special mechanical-drive requirement.

High-frequency brazing eliminates rotor joint failure . . . proved on over 1500 motors operating up to five years without a single failure

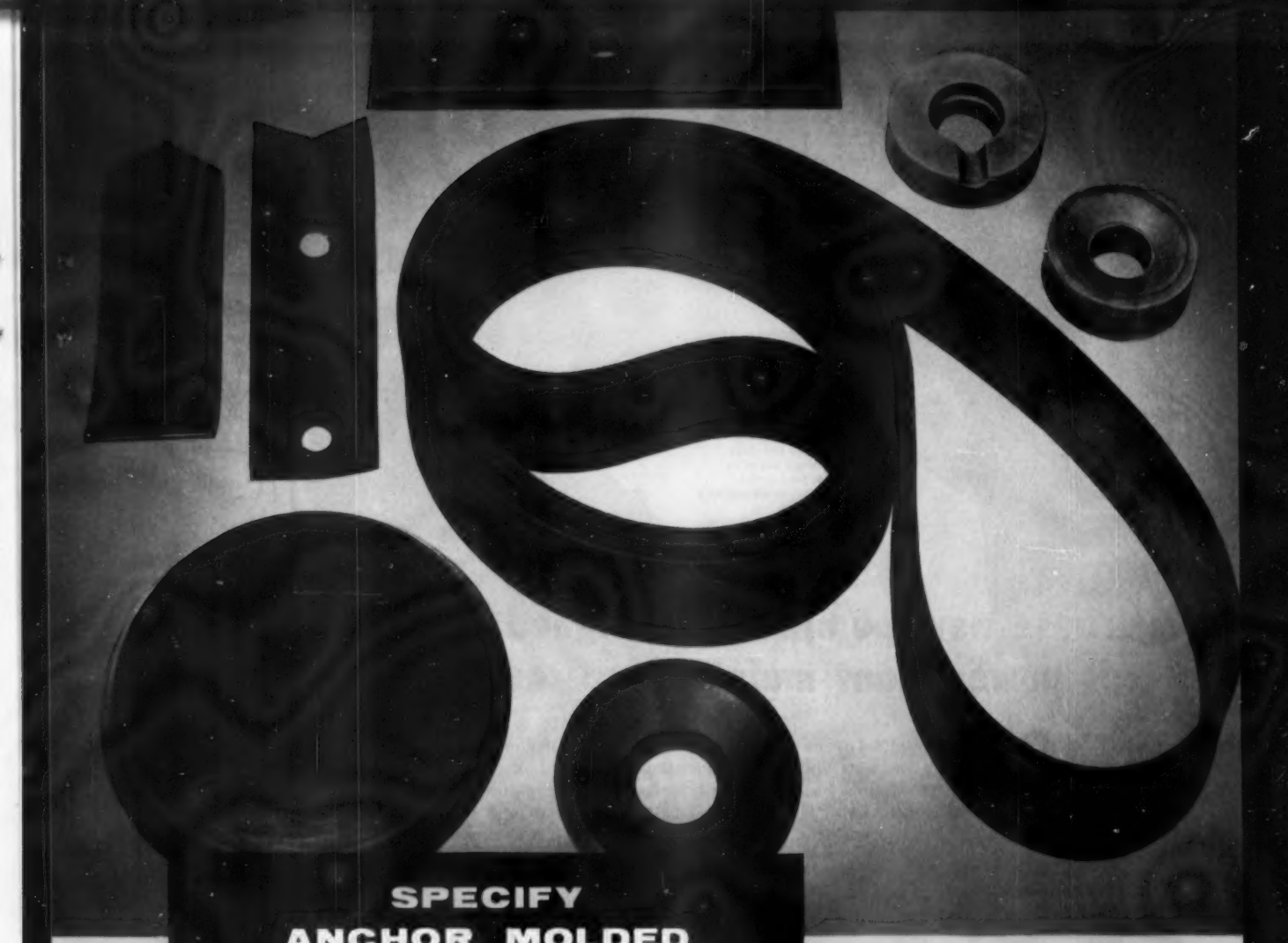
This technique licks the biggest single trouble spot in rotors of large motors. Bars are brazed to the end rings—and connections are tested at the same time. It is the only way to get solid, indestructible joints . . . your positive assurance of reliable operation under the toughest conditions.

You get many important extras in Westinghouse large motors. Thermalastic® insulation, for example, gives over 20% increase in dielectric strength, 10-to-1 increase in voltage endurance—withstands moisture, dust and corrosive atmospheres.

Both of these features have been extensively proved in service. They give you a motor far superior in performance and long life . . . the closest you can come to a completely maintenance-free mechanical drive. For full range of sizes and application assistance, call your local Westinghouse sales engineer, or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10444

YOU CAN BE SURE . . . IF IT'S

Westinghouse



SPECIFY ANCHOR MOLDED RUBBER BOTTLERS SUPPLIES

...for a variety of uses!

The Anchor Packing Company offers a wide variety of Molded Natural and Synthetic Rubber Parts . . . to meet the universal need of industry. Illustrated are Anchor Molded Rubber Bottlers supplies. Molded parts are made from many compounds of natural rubber, Ankoprene, Butyl, Buna N, Buna S, Le-A-Kol, and others!

Our modern facilities enable us to make special molds on a non-profit mold charge basis, and even to do custom molding from your own molds.

Write us your individual needs.

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THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

Two Goulds 2 x 3-9 Fig. 3305 two-stage centrifugal pumps on boiler feed service. These pumps are available in five sizes, with capacities to 1200 GPM, heads to 1000 ft.

These new pumps are designed to cut power plant maintenance costs

Eight special features, designed to insure maximum efficiency and long life, are *standard* in these new Goulds Fig. 3305 two-stage centrifugal pumps.

When you specify these pumps you get, *without extra cost:*

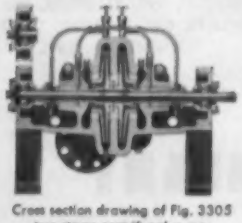
1. Renewable stuffing box bushings.
2. Bearing housings sealed against moisture and dirt.
3. Cowl-type glands suitable for use with quenching liquids.
4. Stainless steel impeller keys.
5. Teflon water-seal rings.
6. Die-formed stuffing box packing.
7. Corrosion-resistant gland bolts.
8. Unique labyrinth diaphragm which maintains thrust balance.

Every one of these features means less maintenance expense for you—less down time of vital equipment in your plant.

And that's not all, for the Fig. 3305 pump offers several other advantages, too. For example, you can choose either a conventional stuffing box or a mechanical seal, to suit your requirements, and you can change from one to the other at any time. Also, the exclusive Goulds patented locking shaft sleeve permits you to change the direction of rotation in the field, without additional parts.

Furthermore, if you use a number of pumps in your plant, the extensive standardization of parts enables you to keep your parts inventory low. Not only are many of the parts interchangeable within the various five sizes of the Fig. 3305 pump, but many parts also are interchangeable with those of the Goulds Fig. 3405 single-stage, double-suction pump.

Send the coupon below for Bulletin 722.6, which gives the complete story of the Fig. 3305 advantages, including specifications, performance curves, and interchangeability charts.



Cross section drawing of Fig. 3305 two-stage centrifugal pump.

GOULDS PUMPS, INC., Dept. PO-11,
Seneca Falls, N. Y.

Please send me Bulletin 722.6 giving details and specifications of Fig. 3305 two-stage centrifugal pumps. I understand that this places me under no obligation.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Goulds PUMPS INC. Seneca Falls New York

Atlanta • Boston • Chicago • Houston • New York
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MEMBER

LINE MATERIAL COMPANY

GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

PLEASE REPLY TO
700 W. MICHIGAN STREET
MILWAUKEE 1, WISCONSIN

May 4, 1955

Mr. M. Marsh
Tempil® Corporation
132 West 22nd Street,
New York 11, New York

Mr. Marsh:

In answer to your letter of April 27 inquiring about our use of Tempilaq in March 1954, we are happy to offer the following information.

Line Material Company was, in March, 1954, developing a series of transmission line power switches. The enclosed photo shows a typical unit. It was necessary to determine the ability of these switches to withstand the heavy short circuit currents required by Industry Standards. Power switches must withstand instantaneous currents of 40,000 amperes and 4 second duration currents of 25,000 amperes.

As shown in the photo switch contact pressure is maintained by non-ferrous springs. The switch was carefully designed so that the springs are not required to carry current. However, it is difficult to predict the paths which will be taken by fault currents such as those described. In order to assure that the switch would not be affected in any way by the heat developed, we applied Tempilaq in the ranges from 200 to 600° F to all critical areas of the switch. The prescribed tests were then conducted in our Short Circuit Laboratory. Subsequent examination of the Tempilac gave us the information we sought.

Tempilaq offers the most practical method of measuring peak temperatures where such a high rate of rise occurs. It also eliminates the necessity of running electrical leads to what could possibly become a high voltage test specimen.

I am proud to report that both your product and ours displayed very favorable characteristics throughout these tests.

R. J. Bertling
Design Engineer
Construction Materials Section

rk

A McGraw Electric Company Division

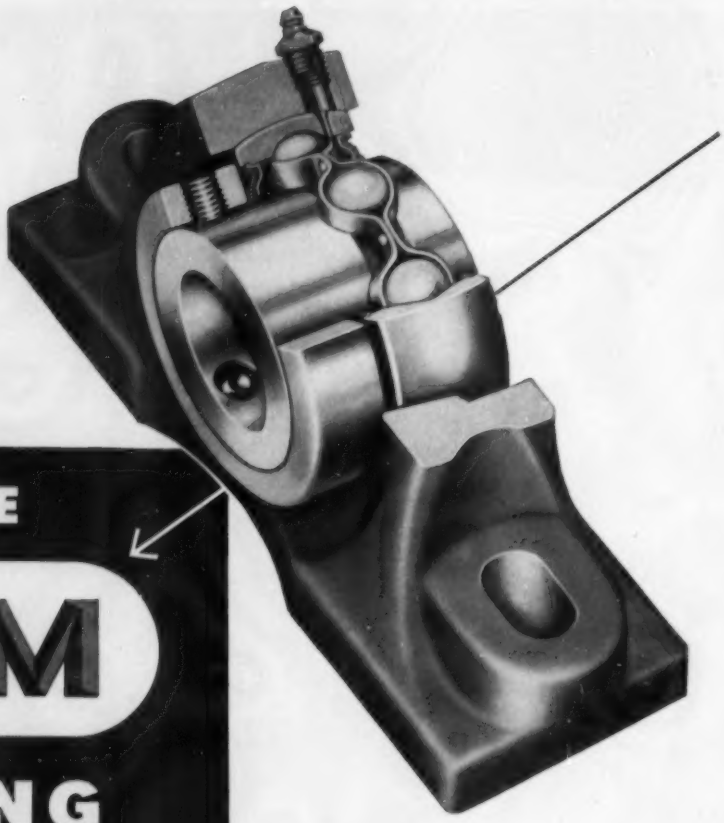
Thank you—Line Material Company—for showing the way!

TEMPILAQ
213°F
101°C

Tempil®
CORPORATION
132 WEST 22nd STREET, NEW YORK 11, N. Y.

Versatile Tempil® products may offer a solution to your temperature problems. . . . Samples are yours for the asking if you will advise what temperatures are of interest to you.

TEMPILSTIKS® TEMPILAQ® TEMPIL® PELLETS
for accurate determination of industrial temperatures



DODGE

SCM

BEARING

A wonderful new Ball Bearing Pillow Block by Dodge . . . for *medium* duty!

More load-carrying capacity . . . larger shaft sizes . . . plus all the features and dependability of the famous S C Ball Bearing line! These are the qualities provided in Dodge S C M, a new line of mounted ball bearings, available in both pillow blocks and flange cartridge type.

Designed for medium duty, these new bearings are of heavier construction, with complete new housings. Metallic-backed Neoprene seals keep lubricant in, dust and dirt out of the bearing. Engineered to stay put, *the seal won't blow!*

S C M bearings are new members of the famous Dodge 30,000 hour line, all of which are sealed, both on and off the shaft. Fully assembled and pre-lubricated at the factory, they are ready to slip on the shaft. Available from Distributors' stocks in shaft sizes from 1-7/16" to 3-7/16".

Write for bulletin with complete specifications.

DODGE MANUFACTURING CORPORATION
3200 UNION ST., MISHAWAKA, INDIANA

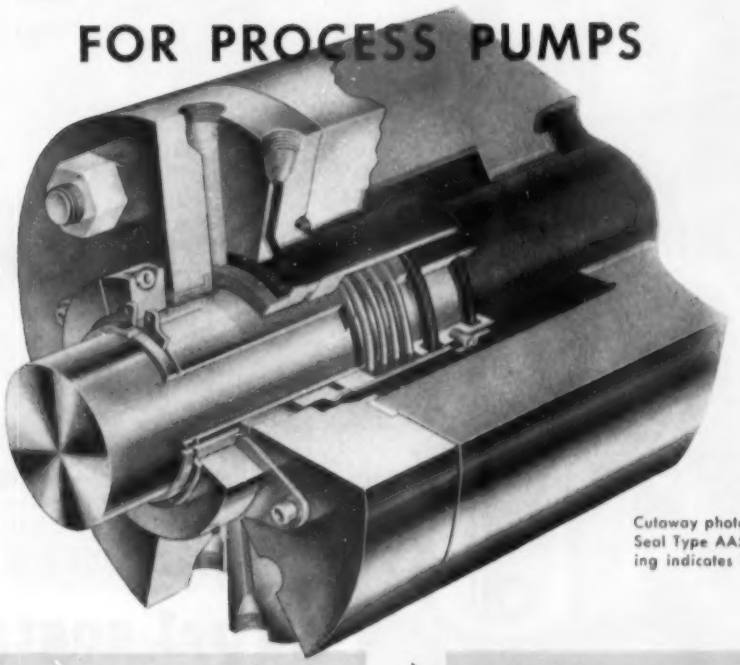
DODGE
of Mishawaka, Ind.

CALL *THE TRANSMISSIONEER*, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

NEW from GARLOCK...

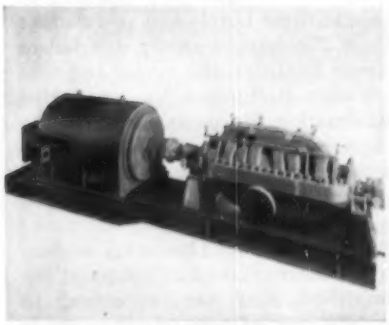
MECHANIPAK* SEALS

FOR PROCESS PUMPS



Cutaway photo of Garlock Unitary Seal Type AA51B-23. Yellow shading indicates liquid being sealed.

- One Piece Assembly
- Quick, easy installation
- Pre-set at factory
- Maintenance-free life



Typical boiler feed pump for which Garlock Unitary Seals are designed.

SAVE installation time, eliminate maintenance costs with Garlock's new Unitary Mechanipak Seals for process pumps!

The entire unit, including sleeve and gland, is furnished completely assembled. The seal is pre-set at the factory—no on-the-job adjustments are needed. The *external* lock and drive is readily accessible—eliminates set-screw drive.

Get all the facts today! Phone your Garlock representative or write for new Folder AD-151.

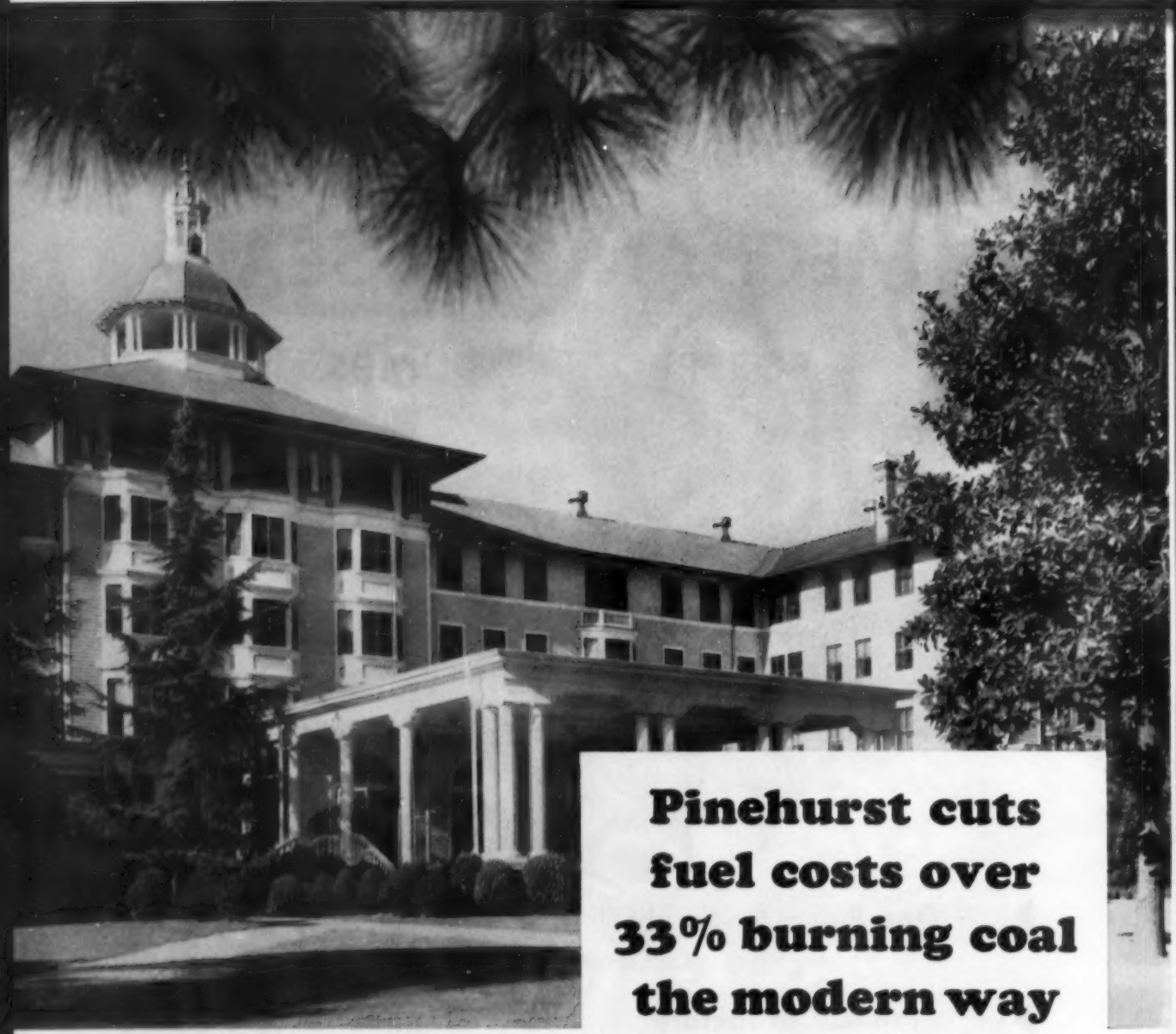
The Garlock Packing Company, Palmyra, New York

Sales Offices and Warehouses: Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Los Angeles, New Orleans, New York City, Palmyra (N. Y.), Philadelphia, Pittsburgh, Portland (Oregon), Salt Lake City, San Francisco, St. Louis, Seattle, Spokane, Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

*Registered Trademark



Pinehurst cuts fuel costs over 33% burning coal the modern way

The central power plant at the famous golfing resort of Pinehurst, N.C., has to furnish a reliable supply of steam to three hotels and seven other buildings. When Pinehurst recently decided to modernize power facilities, the consulting firm of Wiley and Wilson, Richmond, Va., was called in to study the situation. Since coal cost approximately 40% less than the next cheapest fuel, the final decision called for burning coal the modern way. Today two new automatic stoker-fired boilers (only one of which is operated at a time) replace four 150-hp hand-fired boilers. Combustion control is automatic; coal and ash handling is greatly simplified. And now, according to management, "the cost of generating steam is 33.4% less than with the old plant." For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available. • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use. • No smoke or dust problems when coal is burned with modern equipment. • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

How Grid-Type Phase Control IMPROVES RECTIFIER OPERATION

Separate circuits — one for firing, one for phase control — give important operating advantages in excitron rectifiers. The excitation circuit maintains a continuous arc that makes the excitron rectifier much less likely than other types to lose excitation during operation. A separate circuit utilizes the deionizing grid to obtain phase control.

Only excitron rectifiers provide separation of these two functions in separate circuits. Improved operation is the result, because one function is never sacrificed to the other — you get optimum operation from each.

Grid-type phase control permits operation in the clean region near the anode where ion density is lowest, instead of on the surface of the cathode mercury pool where the mercury may be contaminated. Reliability of phase control does not depend on the condition of the mercury. Only excitron rectifiers can give you this important operating advantage.

For more information on grid-type phase control of excitron rectifiers, consult the A-C office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4822

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

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the modern, efficient way to insulate pipe

Take a good look at the unique one-piece glass fiber pipe insulation that insulates a 6-foot section of pipe as quick as you can say "Snap*On!" Then picture the savings in your plant when you put Snap*On on large or small, hot or chilled piping.

These on-the-job photos were taken at a midwestern university where large steam distribution lines in tunnels were recently insulated with Snap*On. The job was done in remarkably short time because of the exceptional ease of application. Workmen were pleased to discover that Snap*On weighed only 1/10 to 1/4 as much as conventional insulations — yet was so fibrous-tough that there was no breakage . . . no mess . . . no clean-up time.

An important secondary saving was the heat saving. Tests conducted on the finished job by the university showed the surface temperature of Snap*On to be 50° lower than that recorded on the insulation formerly used!

These are documented facts. The same sort of superior thermal efficiency and low-cost application can be yours if you insulate piping up to 33" in diameter, where temperatures do not exceed 350°. But see for yourself — write today for samples and Technical Bulletin SO-55 today.

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Thermal and acoustical insulations • Molded glass fiber pipe insulation • Pipe couplings and fittings

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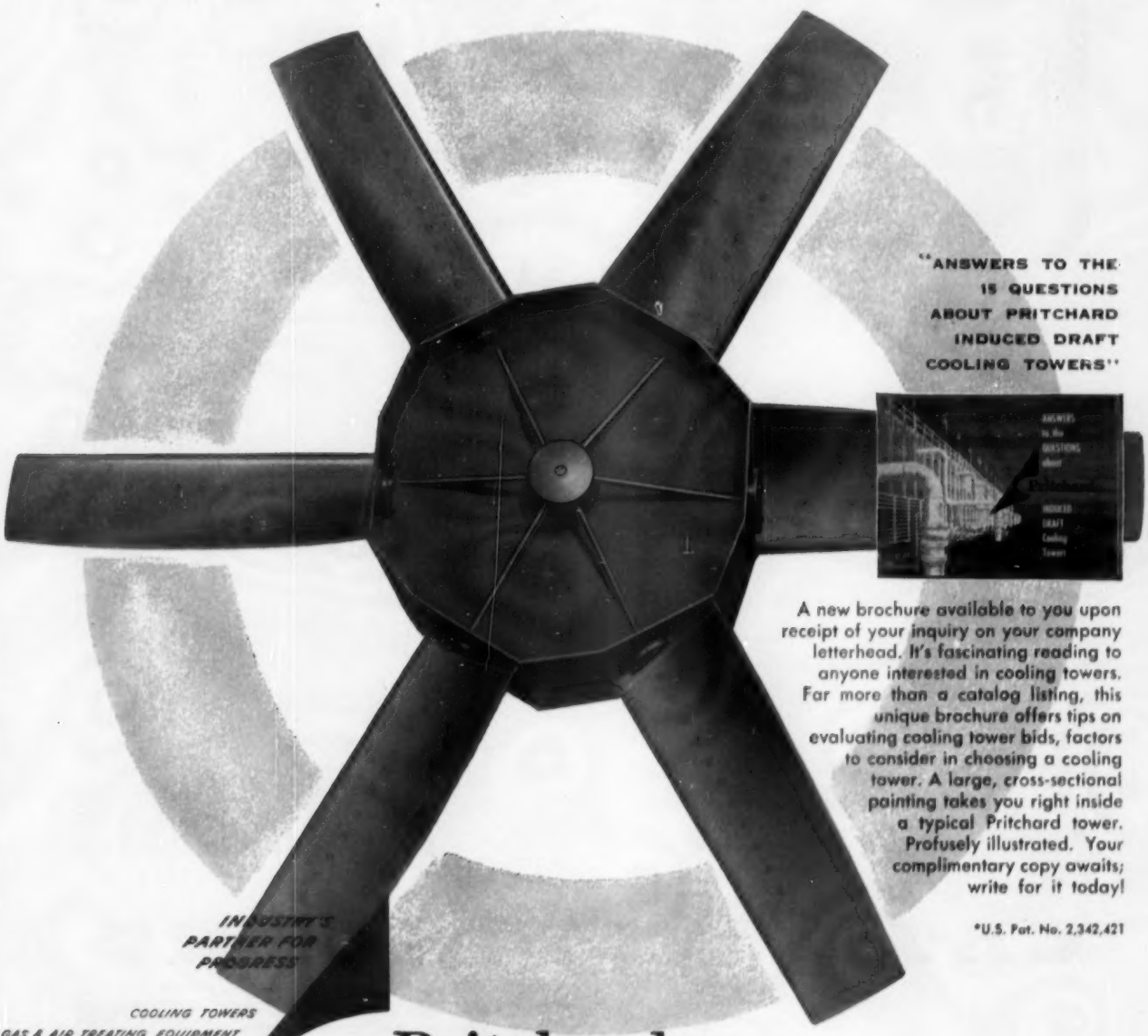
The POWairSAVER fan is exclusive with Pritchard. It was developed specifically for cooling tower service. It develops maximum air flow, economically, because of patented* design and construction.

The blade, of airfoil design, is twisted to pump as much air at the hub as at the tip of the blade. The hub is constructed to allow for no back flow of air near the hub. Thus, you get high aerodynamic efficiency, with low horsepower, on this adjustable pitch, POWairSAVER fan, exclusive with Pritchard!

POWairSAVER blades and hubs are precision-made in jigs for greater uniformity and easy interchange of parts. Monel or stainless steel blades are available to meet specific anti-corrosion requirements.

A six-blade design is pictured. Also available in four and eight-blades. It's exclusive with Pritchard—the POWairSAVER fan—one more reason to choose Pritchard cooling towers!



"ANSWERS TO THE 15 QUESTIONS ABOUT PRITCHARD INDUCED DRAFT COOLING TOWERS"

A new brochure available to you upon receipt of your inquiry on your company letterhead. It's fascinating reading to anyone interested in cooling towers. Far more than a catalog listing, this unique brochure offers tips on evaluating cooling tower bids, factors to consider in choosing a cooling tower. A large, cross-sectional painting takes you right inside a typical Pritchard tower. Profusely illustrated. Your complimentary copy awaits; write for it today!

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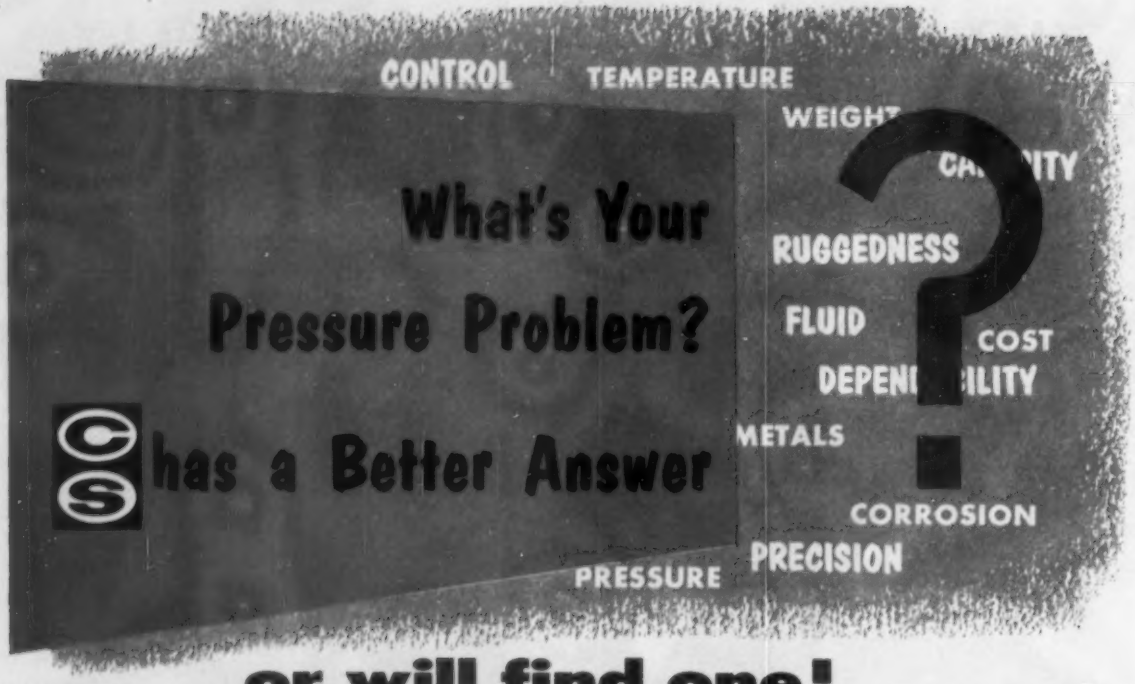
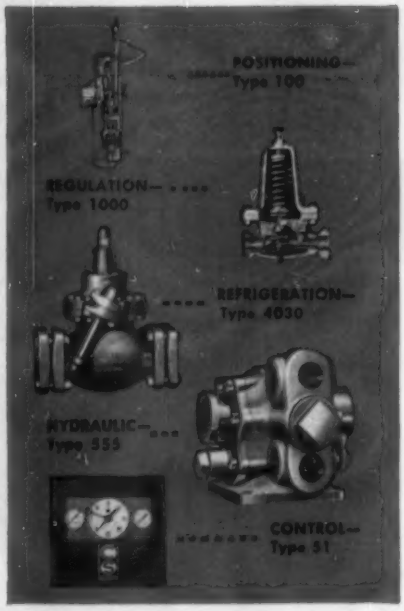


or will find one!

Finding or developing answers that *best suit* individual pressure problems has been Cash Standard's specialty for over a quarter of a century. The solution to *your* problem can be found either in the established Cash Standard line of pressure regulators, instruments and automatic controls, or in Cash Standard's willingness to tackle problems—to modify existing products or design new products to conform precisely to your needs.

For an individual solution to *your* pressure problem, contact the Cash Standard pressure specialist in your area, or write for pressure problem analysis. Write Dept E.

Some Applications Served by Cash Standard Pressure Products



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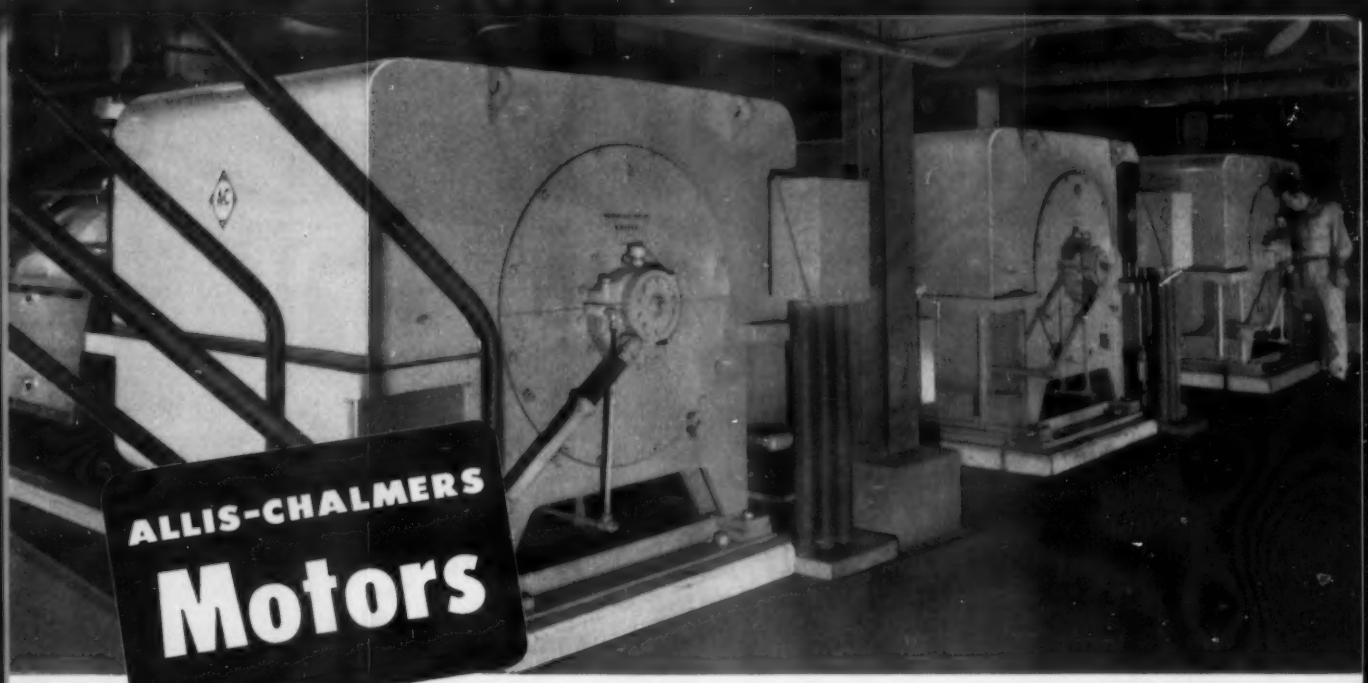
A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls



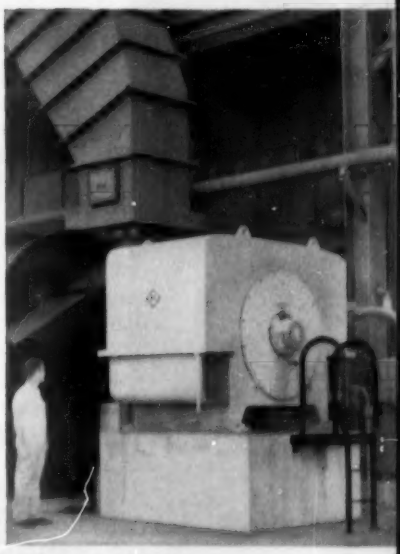
Three of the six 1750-hp, 3575-rpm, 2300-volt Allis-Chalmers two-pole motors providing unusually quiet drives for boiler feed pumps.

Driving ALL Major Auxiliaries

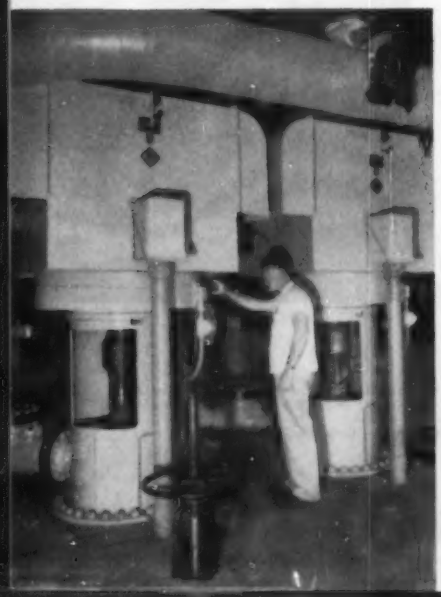
at Houston's New Webster Station

Weather-protected Allis-Chalmers motors are used throughout the modern outdoor Webster Station of Houston Lighting and Power Company. They provide low-cost outdoor installation plus dependable operation under all weather conditions.

These motors are but a few of the complete line of motors Allis-Chalmers builds for power plant service. Check with the A-C office in your district or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-4832

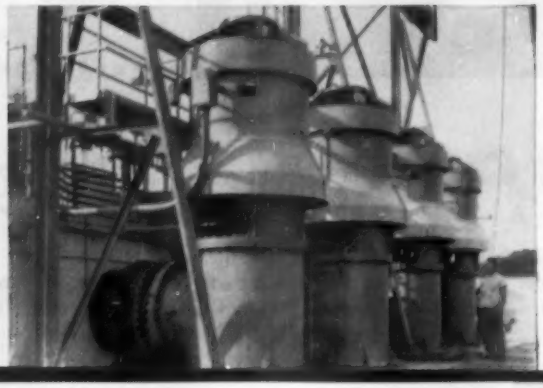


One of four 1250-hp, 880-rpm, 2300-volt cage motors driving forced-draft fans.



Two 350-hp, 1170-rpm, 440-volt Allis-Chalmers condensate pump motors.

ALLIS-CHALMERS

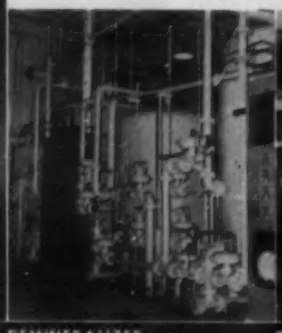


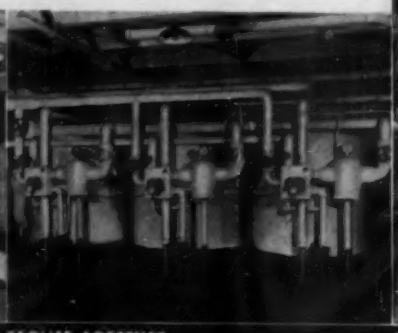
Four 800-hp, 514-rpm, 2300-volt vertical Allis-Chalmers circulating water pump motors.

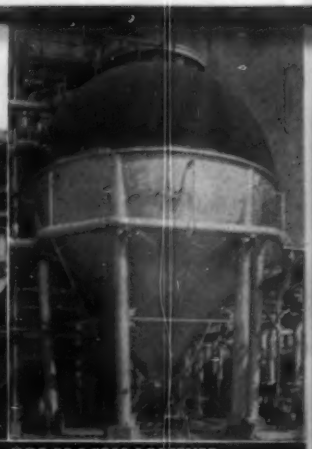
Engineers and Constructors —
Ebasco Services Incorporated

See the Cochrane Booth No. 197 at the Chicago Power Show
Nov. 14-18

DEAERATOR


DEMINERALIZER


ZEOLITE SOFTENER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Engineering and Equipment by **Cochrane** *assure complete water conditioning service*

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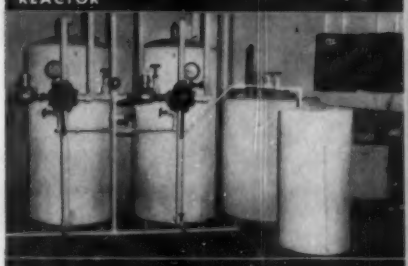
MULTIPORT RELIEF VALVE

For over half a century Cochrane Corporation has pioneered major developments in the field of water conditioning. Today, Cochrane leads in installation of deaeration, hot process and hot lime zeolite equipment.

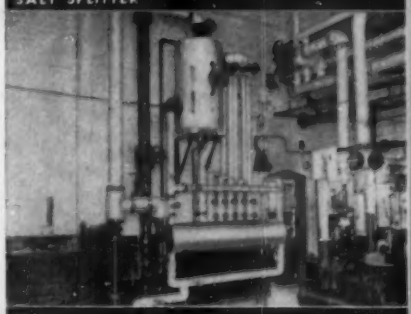
Development of the Cochrane Hydromatic Valve sets a new standard in automatic control for Ion Exchange Processes.

Cochrane's background as heat engineers has also been responsible for the development of steam specialties recognized and used throughout industry today. The C-B Jet Pump improves heat transfer, reduces drying costs with resultant product improvement and usually increases production output.

This complete service, available at Cochrane, provides a single responsibility for continuous satisfactory operation of every installation. It is an assurance that guarantees will be met. Why not consult Cochrane?

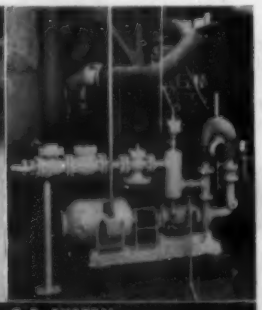

SALT SPLITTER

MULTIPORT DRAINER


CONTINUOUS BLOW-OFF

STEAM PURIFIER

OIL SEPARATOR


C-B SYSTEM

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Representatives in 30 principal cities in U.S.; Toronto, Canada; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.
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Open Eyes and Open Minds

READING David Woodbury's *Beloved Scientist* the other night, I came across a description of Elihu Thomson's visit to the great Philadelphia Centennial of 1876.

He was interested, of course, in the giant Corliss engine that was the centerpiece of the exposition. And like the thousands of opening-day visitors, he tramped the 14 acres of exhibits ranging from a complete, working ordnance plant to a statue of Iolanthe carved in butter, which had to be remodeled every night after the day's heat had done its melting work.

But in the six months that followed he found himself returning time after time to a small booth in a corner of Machinery Hall. Here, overlooked by most visitors, a small steam engine drove a Gramme dynamo. Its current lit a tiny arc, supplied an electroplating tank, and ran a little motor.

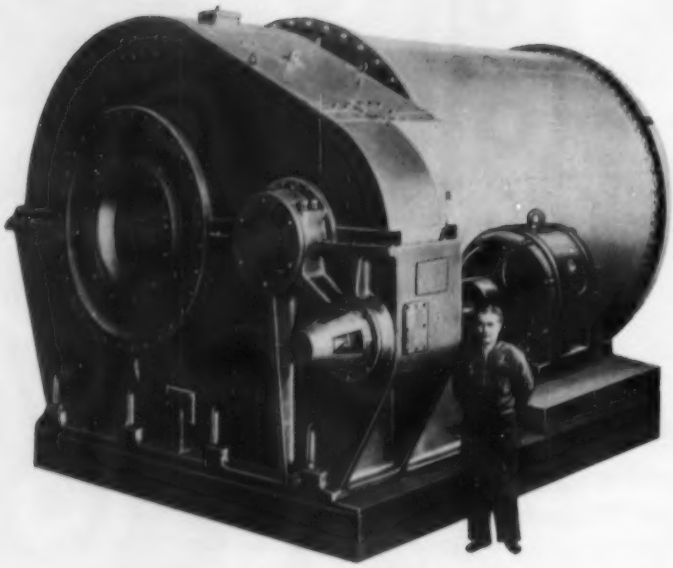
When Thomson wasn't stretching his limited French trying to learn as much as he could about the Gramme dynamo system, he was likely to be found at another obscure booth where an American-made dynamo was on display. Made by the Wallace-Farmer Company of Connecticut, it lit a single arc lamp. Sometimes at night it was connected to an arc outside at the peak of the building. Then the crowd gasped in awe; but few had any idea they were seeing the birth of the electrical age.

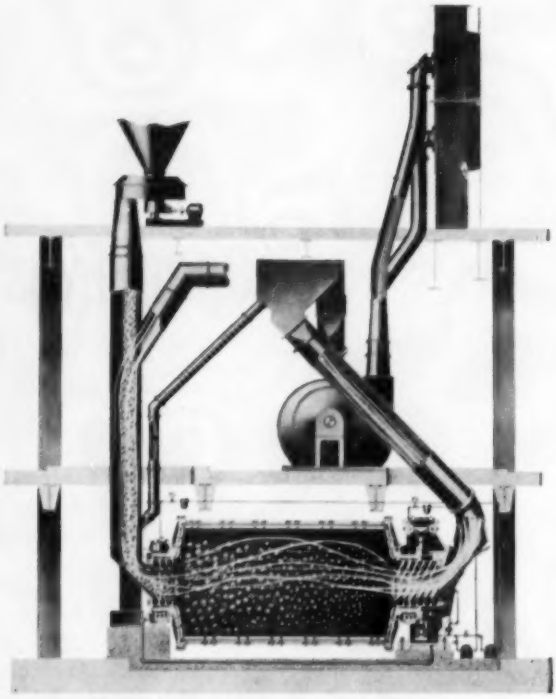
Elihu Thomson knew great things were in the making; from then on his time and ability were devoted to practical invention in the electrical field. Nor was he the only one so influenced. The diaries of many of our electrical pioneers reveal the eye-opening effect of these simple exhibits. And who knows how many of the men who started lighting companies, or built and operated the first plants, were willing to take a flyer on the new-fangled electricity because they'd caught a glimpse of its possibilities at the Centennial?

There's no way of telling, but I'm convinced that expositions and trade shows have influenced more technical activity in this country than anyone gives them credit for. And, even more important, they've sent hundreds of thousands of engineers back home with new ideas, a new awareness of what's ahead in their special field.

This month there are two great power shows, one in Chicago, in connection with the 75th Anniversary Meeting of ASME, the other in Montreal, at the time of the Institute of Power Engineers meeting. Many readers of POWER will attend one or the other. I hope to see both. And I'm also hoping we all can take with us the interested open-mindedness that led Elihu Thomson and others to the really significant exhibits at the Centennial. Who knows what direction-changing innovations we'll see if our minds are as open as our eyes?

INCOMPLETE COMBUSTION





AIR SWEPT TUBE MILL

Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

Send for Literature

THESE ARE FEATURES OF THE KENNEDY PULVERIZED COAL FIRING SYSTEM . . .

FULLY AIR SWEPT

COAL PULVERIZED TO SUPERFINENESS

COAL COMPLETELY CARBURETED READY FOR COMBUSTION

BIG TRUNNIONS FOR AIR SWEEPING

BALLS ADDED WITHOUT SHUTTING DOWN

LOW OPERATING AND MAINTENANCE COSTS

UNBURNT CARBON LOSSES LESS THAN ½%

INSTANT RESPONSE TO CONTROLS

85% TO 90% THROUGH 200 MESH

20% MOISTURE REMOVED WHILE PULVERIZING

PULVERIZE ANY COAL
BITUMINOUS
ANTHRACITE
COKE BREEZE

TRAMP IRON ACTUALLY AIDS IN PULVERIZING

RESERVES OF FUEL FOR INSTANT RESPONSE TO STEAM DEMAND

IT COSTS LESS TO OWN THE BEST!

Are you profiting from All these advantages?

DIGS INTO YOUR PROFITS!

simple arithmetic proves you can save

UP TO $3.00 PER TON

with Kennedy pulverized coal firing systems!

UNBURNT CARBON LOSSES HELD TO LESS THAN ½%

If you are planning to modernize your plant or build a new one . . . or *if you are just interested in cutting fuel* costs . . . let us show you how the KVS Pulverized Coal Firing System saves up to $3.00 per ton by preparing and burning low grade coal the Kennedy way.

By using low priced coal, *pulverized to superfineness by the KVS system,* you obtain maximum heat. Higher priced coal cannot produce any more BTU's and you effect tremendous savings in tonnage costs through the use of properly prepared, low cost coal.

Whether you convert from stokers to KVS pulverized coal firing with air swept tube mills or install an all-new plant, the savings you can effect will more than offset the cost plus the fact that steam capacity is increased and maintenance costs decreased.

KVS air swept ball tube mills enable any power plant to operate at highest efficiency and at lowest cost by providing the fine pulverization necessary to maintain clean furnaces and low carbon losses. Convert your plant NOW to KVS system. Consult our engineers for full information about this coal cost reducing method.

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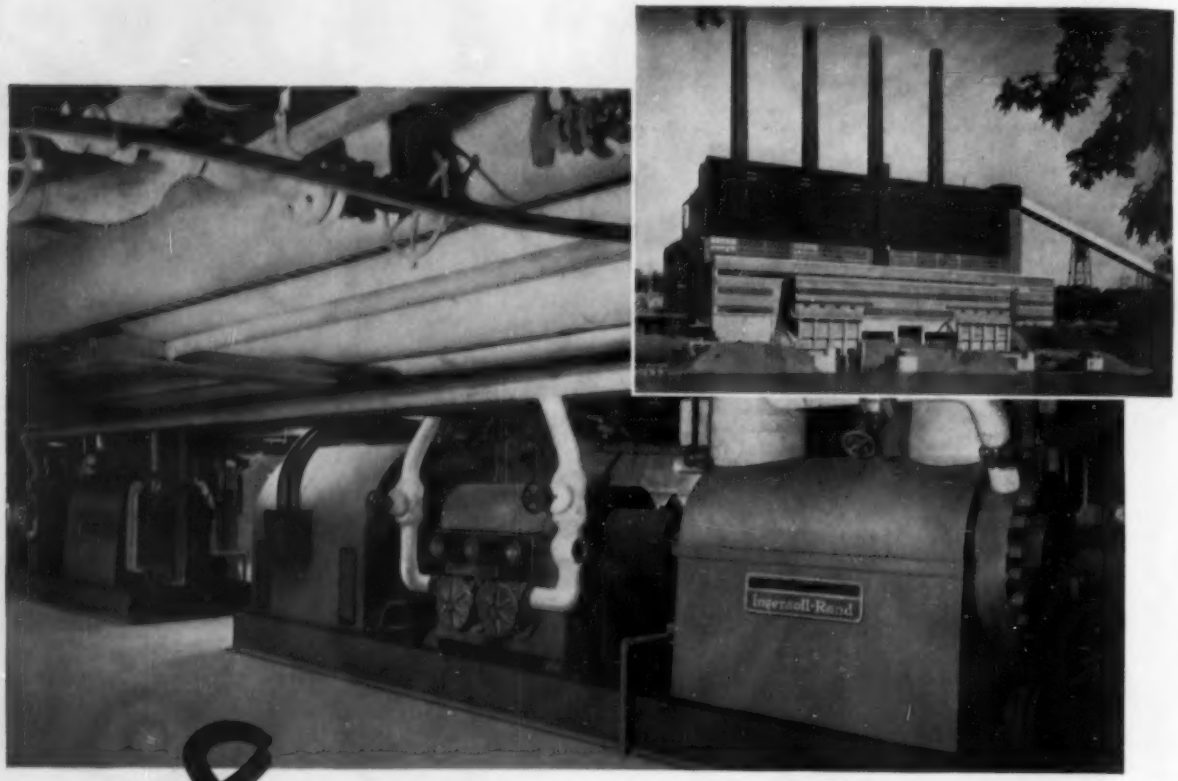

8 I-R BOILER-FEED PUMPS

meet the exacting needs of the Public Service Company of Indiana, Inc.

WABASH RIVER STATION

THE INGERSOLL-RAND *double-case* boiler-feed pumps shown above are typical of *eight* identical units serving the four high-pressure steam generators at the new Wabash River Station, engineered by Sargent and Lundy, for the Public Service Company of Indiana, Inc. Each of these nine-stage pumps delivers 1,760 gpm against a head of 4,650 ft. The 2,500 hp motor driver is hydraulically coupled to the pump for smooth variable speed control. Two pumps serve each of the four generating units.

Three additional eleven-stage pumps are now on order for Unit No. 5 which is expected to be in operation in the spring of 1956.

The cylindrical *double-case* construction of these Ingersoll-Rand pumps permits equalized expansion in all directions when operating at high temperatures, thus meeting the highest standards of overall dependability and sustained high efficiency.

Your I-R pump specialist will be glad to give you complete details.

Other Ingersoll-Rand Equipment at Wabash River Station

- Filtered water pumps, rated 500 gpm, 170 ft. TDH.
- Vertical heater drain pumps, rated 210 gpm, 520 ft. TDH.
- Lubricating water pumps, rated 50 gpm, 75 ft. TDH.
- Evaporator feed pumps, rated 100 gpm, 310 ft. TDH.
- Vertical service water pumps, rated 7,000 gpm, 129.8 ft. TDH.
- Service water pumps, rated 4,000 gpm, 231 ft. TDH.
- Ash sluice water pumps, rated 1,000 gpm, 230 ft. TDH.

10-140

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AIR & ELECTRIC TOOLS • GAS & DIESEL ENGINES • COMPRESSORS • PUMPS • VACUUM EQUIPMENT • TURBO-BLOWERS

B G A SKROTZKI
Associate Editor in Charge

John Strange Paper Co's modernized power plant is an outstanding example of . . .

Planning power services around a process

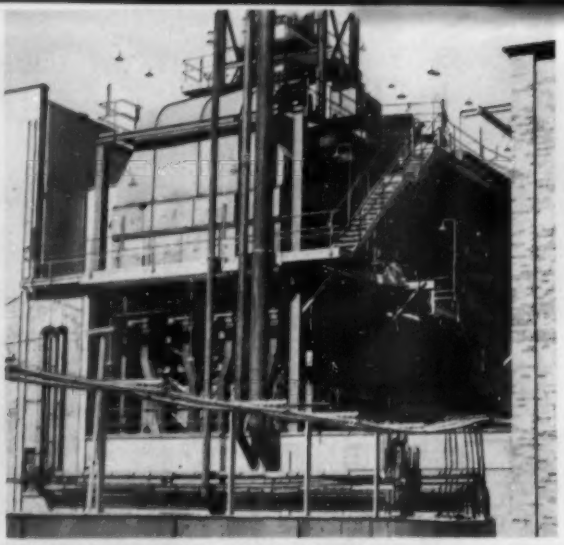
Power MODERNIZATION PROGRAM

A 1955 AWARD WINNER

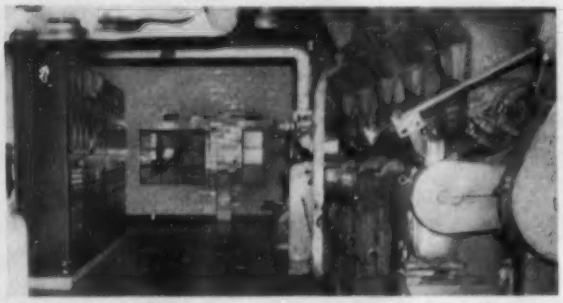
► DOLLARS for steam and electrical power represent a sizable chunk of overall costs in paper-mill production. Trimming these power-service costs loomed large in the minds of John Strange Paper Co's top management when they called in Cummins & Barnard, Inc, Ann Arbor, Michigan, to report on the potential of a sweeping modernization.

C&B sized up the situation this way: The report should accurately reflect the mill's power-service needs and problems. An overly conservative report would discourage the company from going ahead with a modernizing program, deprive them of substantial cost reduction. An overly optimistic report, on the other hand, might lead JS to spend more money than the returns could justify. Result was a practical set of proposals, tailored to fit the specific needs of this paper mill.

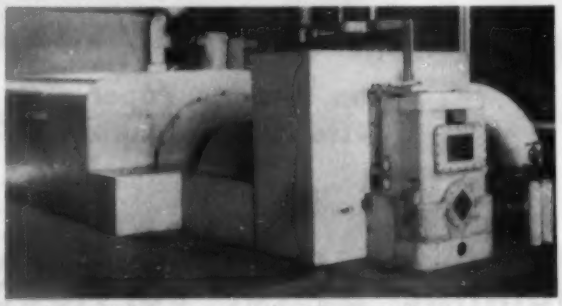
Following through on C&B's recommendations has put the mill in a much better competitive position. It's among the best in the U.S. in Btu used per ton of paper produced. Here's what its modernized services look like. ——►



SEMIOUTDOOR BOILER as seen from dust-collector side. The runway carries electric cable and pipe from plant to mill



SPREADER STOKER, *right,* shares common aisle with boiler and turbine instrument panel, *left.* Supt's office at rear



6250-KW TURBINE and 7500-kva generator. Inlet steam is 700 psig, 825 F. Exhaust steam goes to process at 50 psig

Basic trouble with the old power plant: It didn't have capacity to supply the mill with enough steam or electrical power. Lack of steam at the right pressure was limiting paper production. And buying electricity was relatively expensive—compared to generating it as a byproduct of process steam.

Engineers decided in favor of a single boiler to keep investment cost at a minimum. Also, it would reduce maintenance, operating manpower. Estimates showed that cost difference would be about $225,000 between single boiler and two-boiler installation, both with same steam capacity.

In giving the nod to a single boiler C&B cited experience in other plants. As Engineer Cummins puts it—"The extra investment for two boilers isn't warranted even though the single-boiler plant can go out of service because of a boiler failure. Even with two smaller units, a boiler failure allows only part-load operation—and not economically. Also, forced outages result from many causes other than boiler failure."

Steaming capacity of the boiler is 165,000 lb per hr at 725 psig, 825 F. Spreader-stoker firing on a continuous-discharge grate is regulated by automatic boiler controls. Unit also includes an economizer and mechanical dust collector.

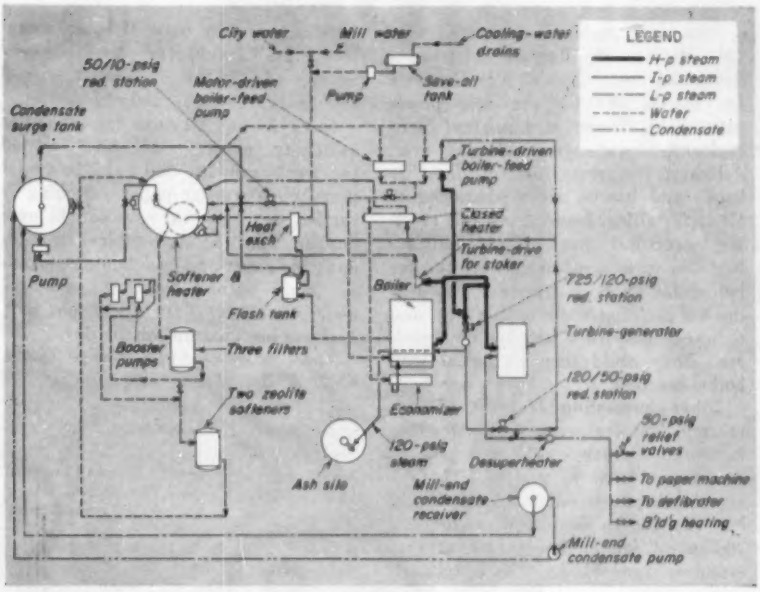
Boiler is semioutdoor type. Its upper part, the coal bunker, dust collector and i-d fans are exposed. Lower part of installation, including the turbine, is housed in a modernized 60-year-old building.

In addition to lower first cost and neater appearance of the semioutdoor design, John Strange is getting added fire protection. Recent fire in an old boiler room at another company's plant caused $100,000 loss. But outdoor unit, adjacent to boiler room, wasn't damaged.

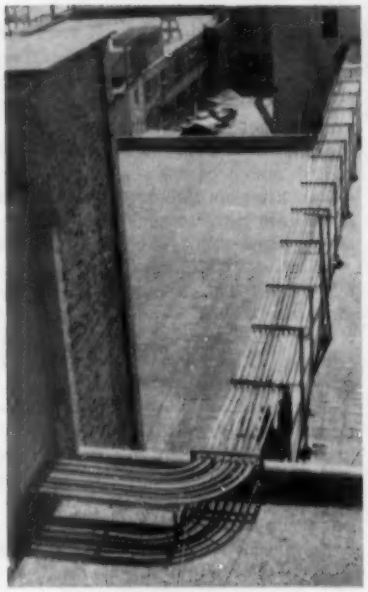
6250-kw-capability turbine drives generator. Generating voltage is 4160 v—paralleling the utility company's step-down voltage. JS distributes electrical power to the mill through five 1000-kva subs and one 2500-kva sub. Completing the electrical-power distribution picture is a 500-kva station-auxiliary transformer (*See* POWER, *Mid-Sept 1955, p 78, for detailed info on electrical setup.*)

Turbine exhausts at 50 psig, supplying the paper mill with steam at needed pressure. With this higher backpressure (compared to 23 psig from the old turbine) greater pressure can be carried in dryers, paper machines run faster. Result: JS produces more paper. Figures point up about 10% production increase. Since many costs stay the same, profits yielded from extra paper are a credit to the modernized power system.

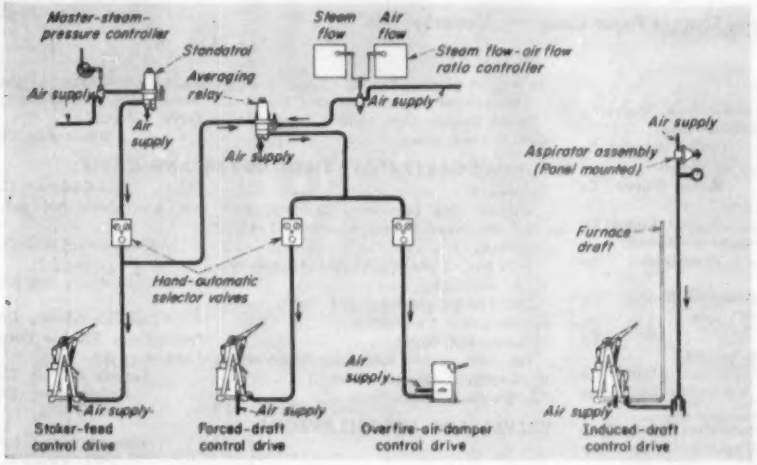
When turbine exhaust steam isn't enough to supply peak process loads, reducing valves pass additional steam. And if exhaust pressure climbs above 52



FLOW DIAGRAM of steam and water, in simplified form, shows how the steam is used for power and process. Reducing-desuperheating stations give system flexibility



CABLE AND PIPING from power plant to mill. Cable is above the pipe enclosure



COMBUSTION CONTROLS include two systems. One operates i-d fan damper to hold desired furnace draft. The other controls stoker feed, forced draft, overfire air

psig, steam exhausts to the atmosphere.

John Strange also blows exhaust steam when starting up the plant or when a paper machine goes out of service without a corresponding drop in electrical load. But records so far show that for 100,000 lb steam, average exhaust to atmosphere is less than 1000 lb per hr—about 1%. To do the same job, a condensing extraction turbine would need a continuous 4000-lb-per-hr flow to the condenser for cooling steam even when makeup steam for the mill passes through a reducing valve.

Additional 3000-lb-per-hr turbine flow would, naturally, boost boiler output. And higher first cost of the condensing-extraction machine, cleaning condenser tubes, pumping condensing water, made the straight noncondensing arrangement look even more attractive.

Tracing out steam-condensate diagram, top of page, note that a 20-in. 50-psig steam line carries process steam to the paper mill, about 500 ft from the power plant. Line capacity is enough to avoid excessive steam pressure drop.

The mill returns all condensate to a receiving tank at about 10 psig. Flash steam from this tank passes through a 6-in. line to the condensate surge tank in the power plant. Additional flash steam flashes from the surge tank at 5 psig, heats makeup water in the softener-heater. So the plant wastes no steam at this point, unless there's more than enough flash steam to heat makeup water. Pumps deliver condensate from the mill receiver to the surge tank, and from there into the deaerating section of the softener-heater.

Throttle steam at 725 psig, 825 F allows the mill to generate practically all its electrical load as a byproduct of steam needed to operate the mill.

Closed heater on the boiler-feed-pump discharge raises feedwater temperature at the economizer to about 285 F, utilizing 50-psig steam. Since this steam first passes through the turbine, John Strange gets greater electrical-generating capacity.

Automatic boiler controls operate pneumatically. Controls include two systems. One operates the i-d-fan damper to maintain a preset furnace draft—about 0.1-in. wg. The other controls stoker feed, forced draft and overfire air. Systems, diagram above, left, are tied together. Initial signal comes from steam pressure. These impulses control stoker feed and air. But

air flow is reset by a signal from the steam flow-air flow ratio controller, maintaining a constant CO_2 reading. If control air fails, operators can run each control drive manually.

Engineers Cummins & Barnard picked boiler controls with spreader-stoker firing in mind. Spreader-fired boilers are more responsive to changes in fuel-input rates than to changes in combustion air supplied. So the controls adjust fuel and air supply, at the same time, from steam pressure and readjust air supply from the fuel-air relation—as measured by the fuel-air ratio controller.

Using old building. Space limits forced JS to house the new boiler and turbine in a brick building—more than 60 years old. The 56-ft span between walls was enough room for equipment. But space had to be used economically. So engineers spotted the i-d fan and dust collector above the boiler.

Structural problems connected with old building: (1) Remove old wooden floors and post supports. (2) Excavate for foundations for the new power plant. (3) Prevent unsupported 50-ft-high brick walls from blowing over.

Heavy, temporary steel girders, tie backs and braces, were positioned to allow installing foundations and erecting structural steel. Once builders had the new structural steel in, for boiler and bunker supports, they tied the old building walls to this steel and removed temporary bracing and girders. They could then go ahead with boiler erection.

Other interesting features of JS's revamped power system: (1) Hot-lime hot-zeolite water - softening system processes 64,000 lb per hr. The de-aerating heater handles 160,000 lb per hr. (2) 250-hp feed-pump motor and 300-hp i-d fan motor operate at generator voltage—4160 v. (3) 15-tph ash-handling system uses 120-psig steam to operate vacuum-type pneumatic conveyor. (4) 50-tph coal-handling system feeds 265-ton-capacity bunker.

Since JS has no room for car-puller switching, photo, p 71, C&B spotted two tracks over the coal unloading hopper. When regular paper switching is carried out, two coal cars can fit over hopper. Since there are several switches daily for paper and less than three coal-car loads burned daily, the arrangement works out fine. By 3 pm, one operator has coal up for the day.

There is no coal-pile storage at the plant. But coal can come by truck, off the docks at Green Bay—about 40 miles away—if necessary.

POWER acknowledges the cooperation of J H Levandoski, Executive Vice-President and H S Johnson, Power Engineer, John Strange Paper Co, Inc. Also, A A Cummins, President and D A Williamson, Resident Engineer, Cummins & Barnard Inc, in furnishing information for this article.

PRINCIPAL POWER-PLANT EQUIPMENT

John Strange Paper Company, Menasha, Wis.

STEAM-GENERATING EQUIPMENT:

Boiler, 1 ..... Union Iron Works Co
165,000 lb per hr, 880 psig, 825 F, 4 drum, Stirling type
Superheater, 1 ..... Foster Wheeler Co
Pendant bare tube, 860 F at 165,000 lb per hr, no bypass
Economizer, 1 ..... Foster Wheeler Co
18,018 sq ft, extended surface
Stoker, 1 ..... Detroit Stoker Co
Continuous ash discharge, 5 feeder, 322-sq-ft effective grate area
Dust collector, 1 ..... Western Precipitation Corp
Mechanical, 93.8% efficiency, 165,000 lb per hr
Induced-draft fan, 1 ..... American Blower Corp
98,000 cfm at 345 F, 12.6-in. static pressure, 885 rpm
Induced-draft-fan drive, 1 ..... Elliott Co
250 hp, 4160 volts, 900 rpm, outdoor type with heaters
Induced-draft-fan drive, 1 ..... Elliott Co
75 hp, 2 speed 600/450-rpm motor, 440 volts, electrically interlocked with 250-hp motor
Forced-draft fan, 1 ..... American Blower Corp
53,200 cfm at 80 F, 3.55-in. static pressure, 860 rpm driven by 50-hp 2-speed motor, 900 and 720 rpm
Boiler setting ..... M H Detrick Co
Steel supported, steel cased
Soot blowers ..... Diamond Power Specialty Corp
Retracting and fixed
Combustion control and boiler instruments ..... Bailey Meter Co
Boiler baffles ..... The Engineer Co

ASH- AND COAL-HANDLING EQUIPMENT:

Flyash reinjection ..... Detroit Stoker Co
Coal-handling system ..... Beaumont-Birch Co
50 tons per hr
Pneumatic ash-handling system ..... Beaumont-Birch Co
15 tons per hr
Coal bunker, 1 ..... Milwaukee Bridge Co
265-ton capacity
Coal scales, 2 ..... Stock Equipment Co

FEEDWATER SYSTEM:

Feedwater regulator, 1 ..... Bailey Meter Co
Pressure heater, 1 ..... Whitlock Mfg Co
200,000-lb-per-hr condensate from 320 to 375 F, with 50-lb steam
Feedwater softener and deaerating heater ..... The Permutit Co
Hot lime, hot zeolite, softening capacity 80,000 lb per hr, deaerating-heater capacity 160,000 lb per hr
Boiler-feed pumps, 2 ..... Pacific Pumps, Inc
Chrome-steel construction, one Elliott Co motor drive, one Westinghouse Electric Corp turbine drive, rated capacity 422 gpm
Chemical-feed pump, 1 ..... Milton Roy Co

TURBINE-GENERATOR, SWITCHGEAR AND CABLE:

Turbine, 1 ..... Allis-Chalmers Co
6250-kw max continuous capacity, 3600 rpm, inlet steam 700 psig, 825 F, exhaust 50 psig, uncontrolled extraction
Generator, 1 ..... Allis-Chalmers Mfg Co
7500 kva, 3 phase, 60 cycle, 4160 volts
Main switchgear ..... Allis-Chalmers Mfg Co
7500-kva for generator and distribution
Station power transformer ..... Allis-Chalmers Mfg Co
Motor-control center ..... Westinghouse Electric Corp
480 volts, molded case, air circuit breakers and starters
High-voltage armored cables ..... General Electric Co
Turbine-steam instruments ..... Bailey Meter Co

VALVES AND MISCELLANEOUS:

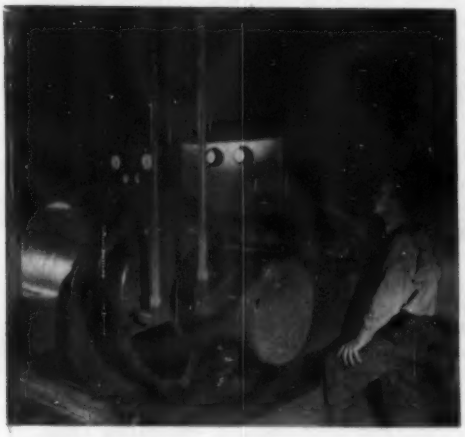
Valves ..... Edward Valves, Inc; Crane Co; Swartwout Co; Minneapolis Honeywell Reg Co; Manning, Maxwell & Moore Inc; Atwood & Morrill Co; J E Lonergan Co; Kieley & Mueller, Inc; Fisher Governor Co
Turbine-room crane ..... Whiting Corp
Hand operated, capacity 20 tons
Reducing valves and desuperheaters ..... Swartwout Co
One reducing valve, 75,000 lb per hr, 725 to 120 psig
One reducing valve, 75,000 lb per hr, 120 to 80 psig
One desuperheater, 75,000 lb per hr, 825-360 F, carburetor type
One desuperheater, 150,000 lb per hr, 390-310 F, carburetor type
Passenger elevator, 1 ..... Otis Elevator Co
1250-lb capacity at 100 fpm, pushbutton automatic

CONTRACTORS:

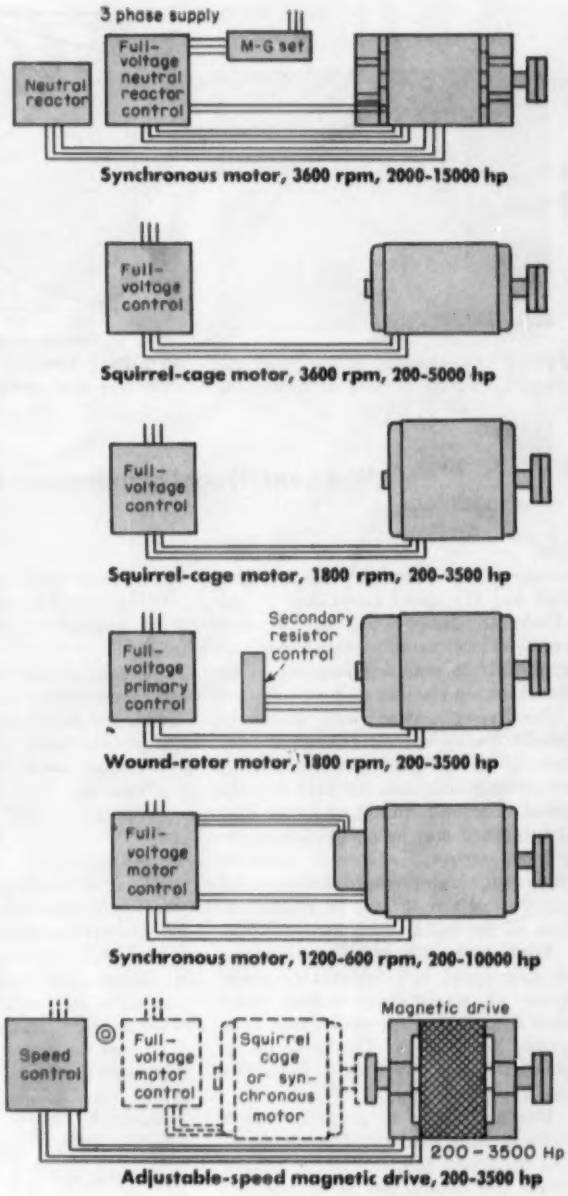
Building construction ..... Fluor Construction Co
Electrical ..... Mullen Electric Co
Heat insulation ..... Bartlett Asbestos & Cork Inc
Piping ..... Asco, Inc
Machinery erection ..... John Hennes Trucking Co

CONSULTING ENGINEERS ..... Cummins & Barnard, Inc

By G L OSCARSON, *Chief Application Engineer*
Electric Machinery Mfg Company



Inertia is the key factor when applying centrifugal compressor motors. Here are salient points that will help you in the job of . . .

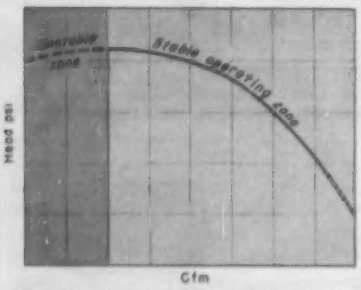


Matching motors to centrifugal compressors

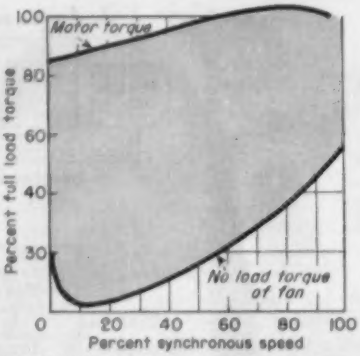
► ESSENTIALLY a multistage fan with backward sloping blades, the centrifugal compressor is relatively simple: It has but one major rotating part. Mechanically it is quite similar to a centrifugal pump. In action, however, it is somewhat different in that part of the head pressure is developed by compression of the gas from centrifugal force: Part is developed by conversion of the high velocity, imparted to the gas by the blades, into pressure in the compressor casing.

Characteristic capacity head of a centrifugal compressor is similar to that for a centrifugal pump. But the compressor curve has a drooping characteristic at low capacities causing it to surge or hunt. This hunting identifies the minimum stable capacity at which the compressor will operate.

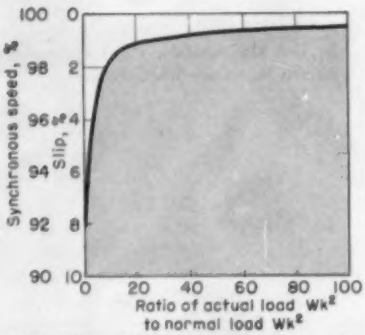
Horsepower needs from the motor end may run to several thousand, particularly in process work. Typical top operating speeds may range from 3600 to 9000 rpm. Most of today's motor-driven compressors operate through



DROOP characteristic at low capacities prompts surging, hunting of compressor



50% FULL TORQUE breaks compressor from rest and provides for acceleration



MAXIMUM SLIP, from which motor pulls into step, is directly affected by WK^2

'the centrifugal compressor is basically a multistage fan'

stepup gears. Capacity control is handled by: (1) speed variations (2) use of suction damper (3) use of inlet vanes. These same methods are also applicable in reducing torque requirements during starting and acceleration.

Breakaway torque with motor at standstill need only be enough to overcome static friction; accelerating torque in general will increase with the speed. Torque required under no load at full speed may be about 35% of the full-load torque. In special cases, by evacuating high-pressure compressors, this no-load torque may be reduced to 15% of the full-load torque.

Synchronous motors. High efficiency, constant speed and controllable power factor of synchronous motors make them first choice for most large compressor installations. They need dc for field excitation, also field contactors and application relays.

Starting torque is generally not a problem with centrifugal compressors. Less than 50% full-load torque usually breaks the compressor from rest and provides adequate torque for reasonable rate of acceleration. Torque from breakaway to pull-in is the accelerating torque. Difference between torque required by compressor and torque developed by motor is net accelerating torque. This is important in determining accelerating time. Latter time can be determined by plotting percent speed along the horizontal axis and percent torque along vertical axis, above, center. For each 10% speed increment, the time can be determined from the formula:

$t = (WK^2 \times RPM) \div (308 \times T)$

where

t = time in seconds

WK^2 = total WK² (flywheel effect) of motor rotor and compressor impeller

RPM = speed increment in rpm

T = average net accelerating torque in lb-ft

By adding the time for each 10% increment from zero to maximum slip speed, the total accelerating time, to the pull-in point, can be determined.

Full-load torque is determined from the formula:

$$T = \frac{HP \times 5250}{RPM}$$

where

T = full-load torque

HP = horsepower

RPM = synchronous speed

Next, find the average net accelerating torque over the speed increment in which the accelerating time is desired. Since most centrifugal compressors are geared to the motor it is necessary to determine the effective inertia at motor shaft. This is done by applying the formula:

Effective WK^2 = compressor $WK^2 \times \frac{(RPM_2)^2}{(RPM_1)^2}$

where effective WK^2 = resultant at motor speed

compressor WK^2 = flywheel effect of compressor impeller

RPM_2 = compressor speed in rpm

RPM_1 = motor speed in rpm

Usually WK^2 of the centrifugal compressor is so high that the flywheel effect of motor rotor, coupling and gears can be disregarded without too much error.

At top induction motor speed, the compressor impeller has a certain kinetic energy stored in it. During acceleration an equal amount of energy is converted into heat in the rotor. This amount is determined by the formula:

$$E = \frac{.231 \times WK^2 \times (RPM)^2}{1{,}000{,}000}$$

where

E = energy absorbed by rotor in kw seconds

WK^2 = total effective flywheel effect

RPM = maximum slip speed (minimum slip)

Motor designer must be careful that the amortisseur winding has sufficient heat-absorbing and -dissipating capacity so it will not overheat during starting cycle or cycles.

Most critical point in starting a synchronous motor is pull-in, which is the transition from squirrel-cage to synchronous operation. At this point the motor is at its maximum induction motor speed, swinging over to synchronous operation when excitation is applied. This pull-in to synchronous speed is handled by attraction of dissimilar poles in rotor and stator. Maximum slip, from which the motor will pull into step, is directly affected by the WK^2 which must be accelerated from slip speed to synchronous speed in about 1/5 sec. In general, the maximum slip can be determined from the formula:

$$S = \frac{C}{RPM}\sqrt{\frac{HP}{WK^2}}$$

where

C = constant depending on motor reactances, etc

RPM = synchronous speed

HP = horsepower

WK^2 = total flywheel effect referred to motor speed

Graphically their relationship is shown above, right, for a given motor. Torque, which motor develops on applying excitation and while connected to load, is defined by NEMA as its

Squirrel-cage and wound-rotor designs are used too!

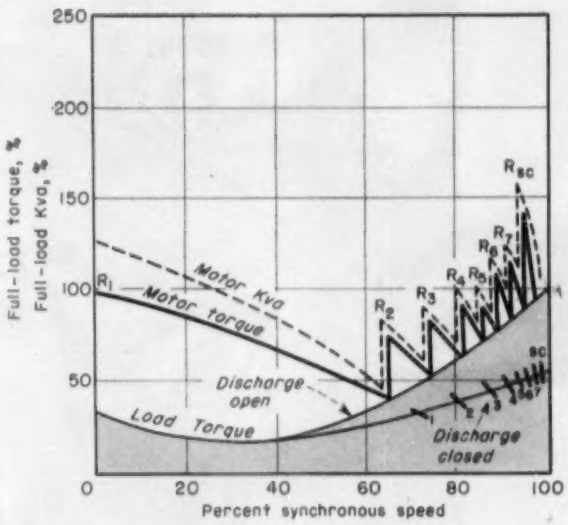
Both the squirrel-cage and synchronous motor have essentially the same type stator, develop a similar rotating magnetic field. As pointed out in POWER, June 1955, p 87, the squirrel-cage unit has a uniformly distributed set of bars in rotor's outer periphery. These bars are connected by continuous end rings.

Compared to the synchronous motor, applying a squirrel-cage motor is simple. Starting and accelerating torques are usually no problem. Compressor operates at the maximum speed the motor brings to it—usually about 98.5% synchronous speed. Accelerating time and heat-energy absorbed in the rotor are determined exactly, as with the synchronous motor. Of course, there is no pull-in problem.

Wound-rotor slip-ring induction motor has a stator identical to the squirrel-cage unit. But rotor has a polyphase winding with same number of pole pairs as stator. It's this winding that connects to slip rings. Then, instead of connecting to an excitation source as for synchronous motors, these rings tie electrically to an external resistor that can be short-circuited in small increments.

Starting step-resistor for a wound-rotor motor is usually selected to provide 100% of full-load locked-rotor torque at about 125% of full-load kva. This is a far lower kva than is possible with squirrel-cage or synchronous motors. More external resistance means a high value of torque at standstill, but a constantly decreasing torque at increased speeds. Low value of rotor resistance gives high torque at high speed so, after motor accelerates to maximum speed it will reach on maximum resistance, a portion of the resistance is cut out. Motor then develops an additional torque at higher speed, with less external rotor resistance, accelerating to a new high speed. Successive resistance steps may be cut out, resulting in higher torque values at higher speeds until the rings are short circuited. At latter point the motor operates virtually as a squirrel-cage motor.

Since wound-rotor torque-speed curve can be modified by changing external resistance, sketch above, operating speed can be lowered or raised by cutting resistances in or out of secondary circuit. This may be done manually or automatically, providing a means for controlling compressor capacity by speed control.



Wound-rotor motor has a tremendous advantage in accelerating high-inertia loads in that substantially all the heat energy developed in rotor circuit is dissipated in external resistor. Similar situation prevails during reduced speed operation. There is a constant secondary slip loss, determined by the formula:

Hp slip loss = (percentage slip × load) ÷ (100 − percent slip)

Practically all this loss is absorbed in external resistor.

---

pull-in torque, sometimes further defined as *load* pull-in torque.

Motor manufacturer can rarely duplicate on his test floor the load and inertia that the motor must pull into step. His test is, therefore, based on the torque that the motor develops on the amortisseur winding at 95% speed. This is known as *nominal* pull-in torque. Knowing connected load WK^2, motor designer must be able to convert load pull-in torque to some definite value of nominal torque that he can design. In very high inertia loads the design, or nominal, pull-in torque may have to be as much as five times the *load* at pull-in speed.

In view of the tremendous effect of inertia on the ability of a motor to pull a given load into step, NEMA has established a table of normal load WK^2 values. Centrifugal compressor's inertias will usually run from 12 to 30 times this value—higher than pumps and lower than chippers or band saws.

Motor manufacturers are interested in the no-load torque as this determines speed the motor reaches on amortisseur winding plus the WK^2, which pins down the maximum slip for motor to pull into step on applying excitation.

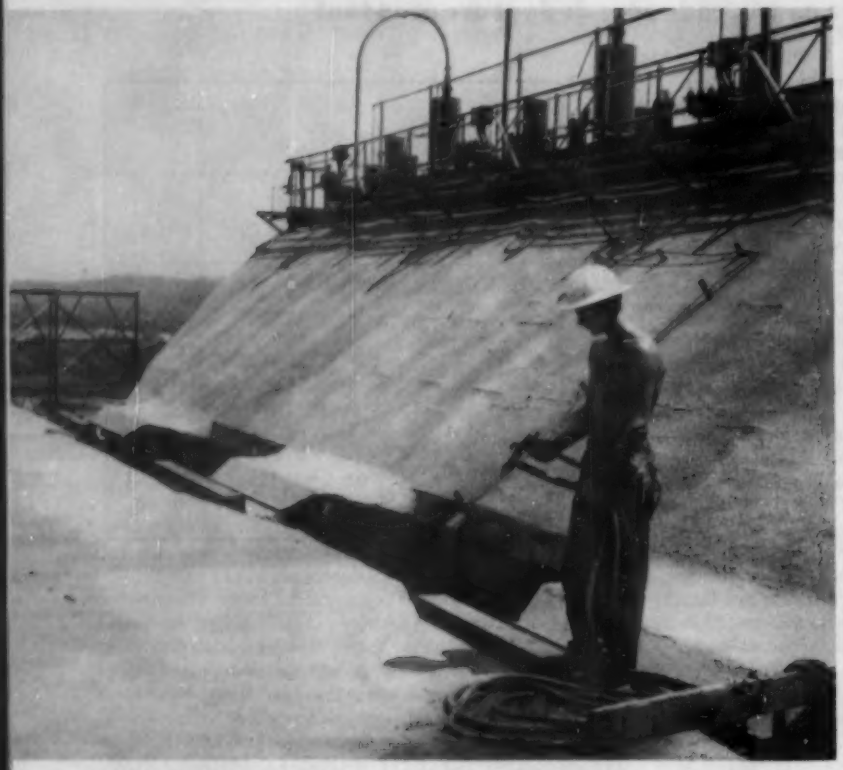
Consider synchronous-motor drives when horsepower rating exceeds motor speed. Example: At 3600 rpm, synchronous motors *may* be used for ratings of 2000 hp and higher, and *should* be used for all ratings beyond 5000 hp. Lowest first cost in large synchronous motors, 2000 to 6000 hp, will be in the 600- to 900-rpm range. But, the speed-increaser cost goes up rapidly with increase in gear ratio. Take a compressor operating at 7500 rpm, requiring a 10,000-hp motor. This combination has lowest motor plus gear cost at motor speed of 3600 rpm. Difference in speed-increaser cost more than offsets higher cost of 3600-rpm motor.

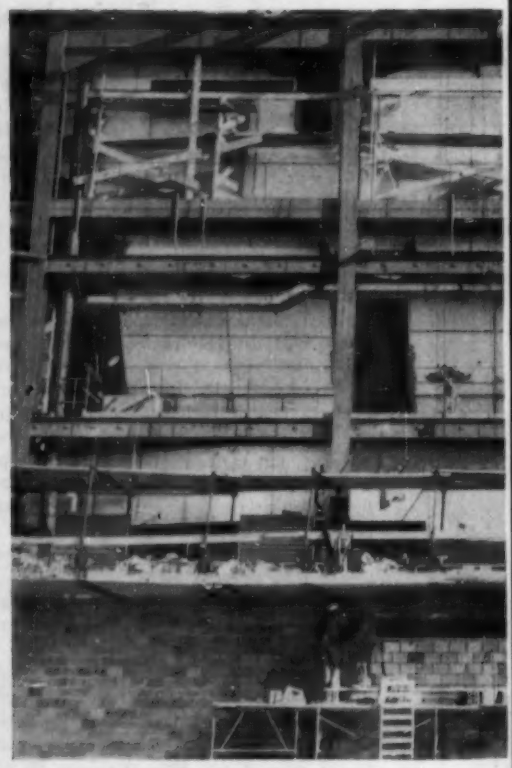
Enclosures. Selecting the proper enclosure for any motor is a matter of knowing what is available and specifying the design best suited to ambient conditions. For a glance at typical modern designs and tips on selection, see POWER, June 1955, p 76.

Slip couplings. Keep in mind that synchronous and squirrel-cage motors are essentially constant-speed drives. Variable-speed operation is often a desirable method of controlling centrifugal-compressor capacity. One way of getting variable-speed operation, with constant-speed drive, is to insert a slip coupling between motor and load. Slip loss resulting from this type of operation is equivalent to secondary loss in a wound-rotor motor.

Magnetic drive is one form of slip coupling controlled by a feed-back circuit and capable of extremely accurate speed control. Control may be made

(*Continued on page* 208)





HEAVY ELASTIC COATING being spread over glass fabric reinforcement covering the special duct insulation on the boiler breeching. This elastic coating is fibered to give greater strength and ductility before and after application on duct

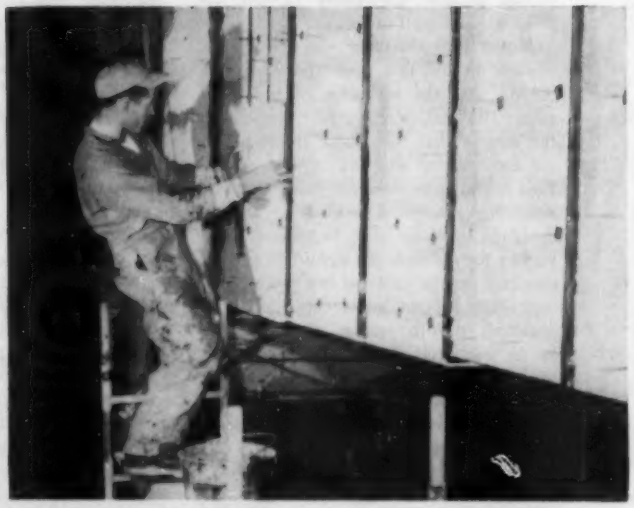
Heat-insulation tips from the nation's

► CLIFTY CREEK STATION, at Madison, Ind., and Kyger Creek Station, near Cheshire, Ohio, together cost $325 million. They furnish power to Atomic Energy Commission's new $1.25-billion uranium-diffusion plant, Portsmouth, Ohio.

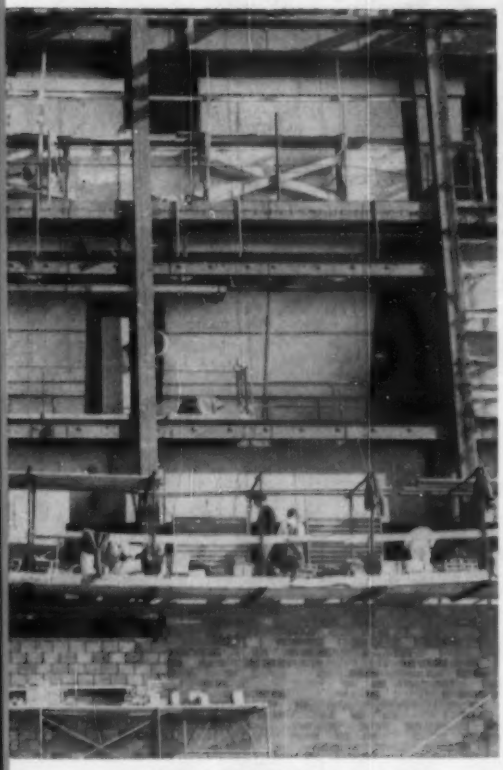
Extensive use of thermal insulation will help make these plants the nation's most economical and efficient power-generating stations. Kyger Creek has a 1075-mw capacity, Clifty Creek 1290-mw. Both plants have been operating since last January, delivering power to AEC.

Fiberglas and Kaylo insulations, both supplied by Owens-Corning Fiberglas Corp, are used on the piping, breechings, boilers and ducts to conserve heat and protect operating personnel. The photos on these two pages show many application details. The $4-million insulation contract placed with North Brothers, Atlanta, Ga., is believed to be the largest single insulation order in the electrical industry's history.

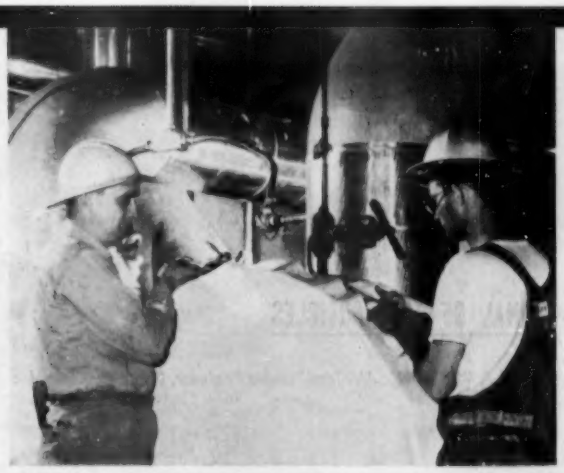
American Gas and Electric Service Corp direct and supervise station construction. Clifty Creek was designed and engineered by the Service Corp, Kyger Creek by Sargent & Lundy.



RECIRCULATING-GAS DUCT has one 2-in.- and one 1.5-in.-thick layer of insulation, impaled over pins shown on the duct



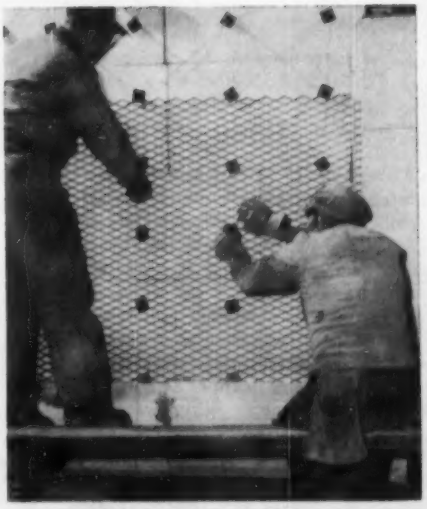
HOT-GAS FLUES, three in number, serve the plant boilers, have block insulation



8-OZ CANVAS COVER being installed over 2-in.-thick insulation on the removable head of a high-pressure feedwater heater

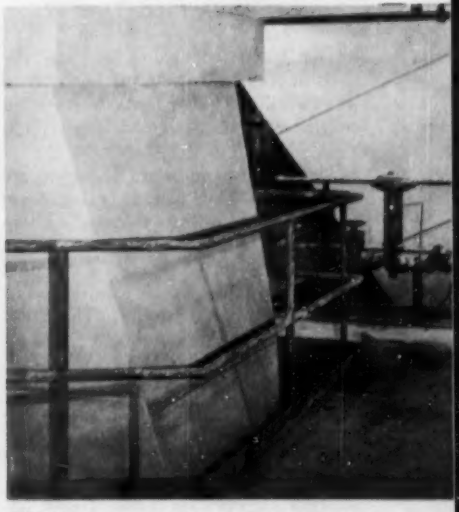
ALUMINUM JACKETS being installed over insulation on boiler hanger rods. The jackets protect personnel and insulation

two top-efficiency steam plants



EXPANDED METAL LATH being installed on the insulation on the boiler sidewalls

BURNER WINDBOXES have two insulation layers, 2 in. thick, impaled over pins

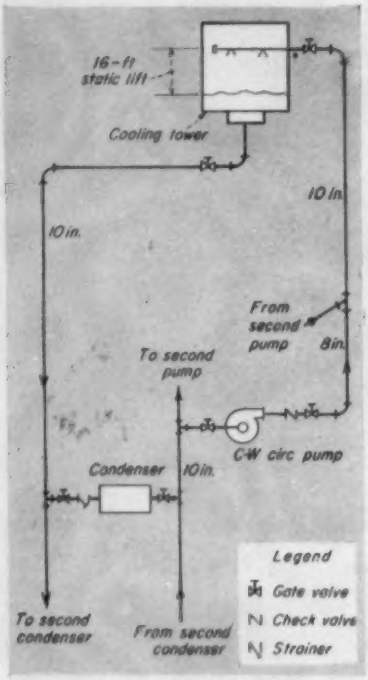


DUCTS have mineral-wool cement finish over the insulation; makes a neat job

FINAL OF TWO ARTICLES

By R A ROSTON, *Air-Conditioning Engineer, Kerby Saunders, Inc*

After pinning down system design to suit the temperature and humidity conditions, we work out data needed to choose the equipment



CONDENSER-WATER piping system

Air conditioning for multi-story buildings: selecting equipment

► WE DISCUSSED cooling-load calculations in August POWER, pp 78-81. Now let's work out the steps in selecting equipment and designing pipe, ductwork.

Air-handling units we'll choose are factory built. They include casing, drain pan, blower, chilled-water coil, filters and motor. We decided to use two units per floor (August POWER) so our next step is to specify air-handling and chilled-water-coil capacity. These figures pin down air-handling unit selection.

Figure for required air flow is 10,250 cfm per floor (August, p 81). Each unit thus handles 5125 cfm. Manufacturer's tables show that a 6-row 10.2-sq-ft cooling coil does the job—at 500-fpm air velocity. Cooling load figuring was based on 1500-cfm outside air per floor. So each air-handling unit must pass a minimum of 750-cfm outside air and a maximum of 4375-cfm return air.

During intermediate seasons, 100% outside air cools the building. Return-air dampers are closed.

To cool air to 56.3-F apparatus dew point (August, p 81) we must circulate the right quantity of chilled water—and at the required temperature. Referring to coil manufacturer's selection tables, 43-F water, with a 10-F temperature rise through the coil cools the air to its apparatus dew point. Water velocity through coil won't exceed 4 fps. Using formula:

$$Q = \textit{total heat gain} \div (\Delta T \times 500)$$

where

Q = chilled water per floor, gpm

500 = 60 min per hr × 8.34 lb per gal

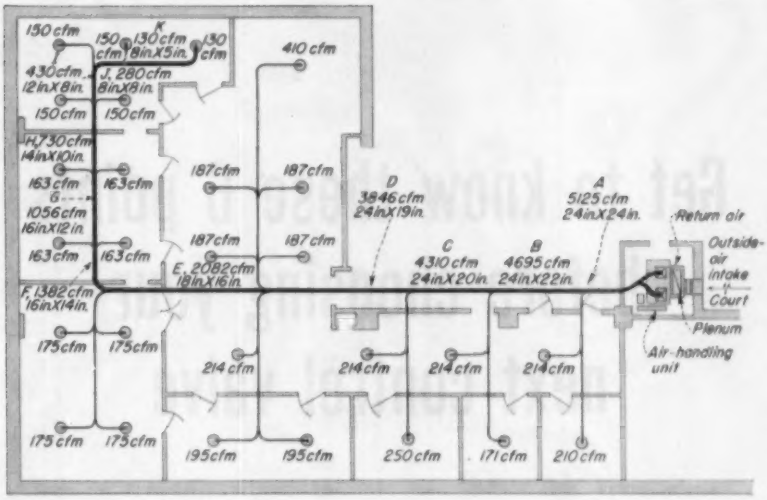
ΔT = water-temp rise, F; we get,

$Q = 293{,}920$ Btu/hr/floor ÷ (10 × 500)

$Q = 58.7$ gpm/floor

We've already figured on 24.5 tons of refrigeration per floor. So 2.4-gpm chilled water passes through chiller for each ton. Based on 700 tons for the entire building, 1680-gpm chilled water must be circulated.

Next step: choosing pumps for chilled-water and condenser-water circuits. To get discharge head needed on chilled-water pumps, add up pressure drops through chilled-water coil, chiller, piping, fitting and valves—to the coil farthest from pump. Manufacturer's data show that coil-pressure loss is 20 ft; chiller loss, 28 ft. Piping-system friction loss is 74 ft. Since two chilled-water pumps operate in paral-



Duct layout and pressure-drop calculations

Section	Air volume, cfm	Friction loss, in. wg per 100 ft	Duct dia, in.	Velocity fpm	Equiv rectangular duct, in.	Equiv duct length for fittings	Actual length of duct, ft	Total friction drop in branch, in. wg
A	5125	0.09	26.0	1400	24 × 24	—	8	0.0072
B	4695	0.09	25.0	1350	24 × 22	—	15	0.0135
C	4310	0.09	24.5	1310	24 × 20	—	12	0.0108
D	3846	0.09	23.5	1300	24 × 19	—	21	0.0189
E	2082	0.09	18.6	1100	18 × 16	—	24	0.0216
F	1382	0.09	16.0	1000	16 × 14	2	8	0.0072
G	1056	0.09	14.5	950	16 × 12	—	10	0.0090
H	730	0.09	12.6	860	14 × 10	—	11	0.0099
I	430	0.09	10.2	760	12 × 8	—	7	0.0063
J	280	0.09	8.8	680	8 × 8	2	4	0.0036
K	130	0.09	6.5	550	8 × 5	—	10	0.0090
	Total							0.1170

lel, each pump handles 840 gpm at 122-ft discharge head. Brake horsepower, for 73% pump efficiency, is 35.4 bhp. Two double-suction, horizontally split centrifugal single-stage pumps, driven by 40-hp 1750-rpm motors, do the job.

Selecting condenser-water pumps, drawing, p 80, involves the same procedure. But total discharge head is governed by pressure drop through condenser, cooling tower, its connecting piping and static lift—the actual distance, in feet, required to lift the water between the cooling-tower sump and its spray nozzles. Total condenser water circulated, based on 3 gpm per ton (August, p 81) is 2100 gpm. Pressure drops through condenser and cooling tower are 23 ft and 15 ft. Actual height of nozzles over sump is 16 ft. Total pressure drop through piping system is 76 ft. Choice: two centrifugal pumps, operating in parallel, each discharging 1050 gpm at 140-ft tdh. Assuming 80% pump efficiency, pumps need 46.5 bhp. Units can be same design as chilled-water pumps, driven by 50-hp motors.

Standby pump is connected to back up either chilled-water or condenser-water pumps. So it must be big enough to handle the condenser-water flow—and it can't be too big to operate in the chilled-water circuit (for pump hookup, see August, p 78). This unit can be same as condenser-water pump. Orifice plate or throttling globe valve in the chilled-water system boosts total head against which this pump operates, thus matching system and pump characteristics.

Pipe sizes. *ASHAE Guide, Fig. 4, p 1099,* correlates flow and friction-loss data for "Fairly Rough Pipe." Using water flows we've just figured, pipe sizes are picked out to minimize velocity and pressure drop. Friction loss between one and two psi per 100 feet is reasonable, and keeps piping costs from getting out of hand. Summing up friction losses in condenser-water piping, we get 32.8 psi or 76 ft. Similar calculations for chilled-water piping yield 74 ft—to most remote cooling coil.

Duct design. Drawing, left, shows section of a typical floor layout with air-supply ducts. Sizing is based on the equal-friction method. Recommended practice limits air velocity in supply duct to 1400 fpm. From *ASHAE Guide, Fig. 2, p 723,* we find (for 5125 cfm) that equivalent round duct is 26 in. in diameter and friction loss is 0.09-in. wg per 100 ft. Table, left, sizes ducts for this friction drop.

Loss due to elbows is based on L/W ratio from *ASHAE Guide, Fig. 5, p 730.* Branch-line ducts are sized by same method as main supply duct. Since main duct represents longest equivalent run, we use it to choose air-handling fan.

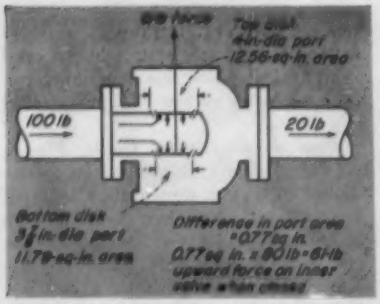
Important: Since branch ducts have excess static pressure, be sure to provide dampers at all take-offs, to balance system.

Air-handling-fan design depends on total air flow and total pressure. Pressure includes friction loss in the longest equivalent duct, in the diffuser and in the return or outside-air systems—whichever is greater. Since we're using hung ceiling as the return-air plenum, friction drop through the outside-air louver and screen is greater. Adding losses through air distribution system:

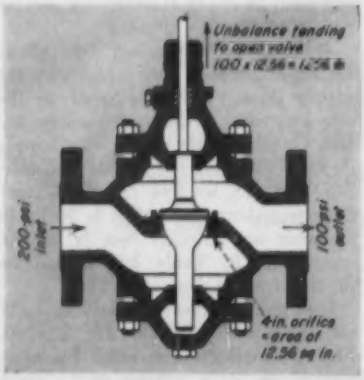
Section	Friction loss, in. wg
Supply duct	0.1170
Supply diffuser	0.0280
Outside-air-intake louver and screen	0.200
Total	0.345

Manufacturer's data show that friction drop through the air-handling unit is 1.1 in. wg. This includes the intake, filters, cooling coil and discharge. Allowing a 5% safety factor, fan should handle 5125 cfm at 1.5-in. wg.

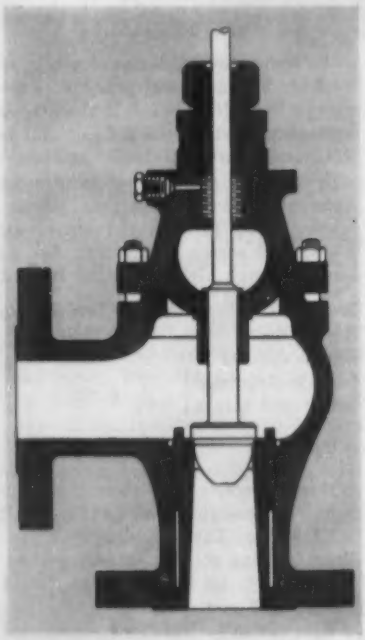
With these calculations completed we're in a position to specify requirements of all major equipment.



1 Double-port inner valve keeps unbalanced thrust on the stem to minimum



2 This top-and-bottom guided single-port valve produces a big unbalance



3 Angle valves pass erosive-corrosive fluids out of the body more quickly

Get to know these 6 points before choosing your next control valve

A control loop is no stronger than its weakest link. All too often the control valve is that link—mainly because one or more of these six points has been overlooked:

• Valve size • Body pattern • Body and trim material • Inner valve • Stuffing box • Diaphragm operator

By H W KINNEY, *Sales Engineer, Fisher Governor Company*

► THE VAST MAJORITY of engineers responsible for power services are not instrument and control specialists. But they're often called on to choose a control valve to fit a new or modernized piping system in the plant.

Suppose you're faced with the job of selecting a control valve that must accurately respond to a pneumatic controller. What points should you consider to make sure you get the right valve? The key factors boil down to the six points listed above. Let's take them one at a time, see how they apply.

1 Valve size

Assuming the control valve is the same as the line size can lead to real trouble. Choose valve to match the flow-rate and pressure-drop conditions needed or allowed in the system.

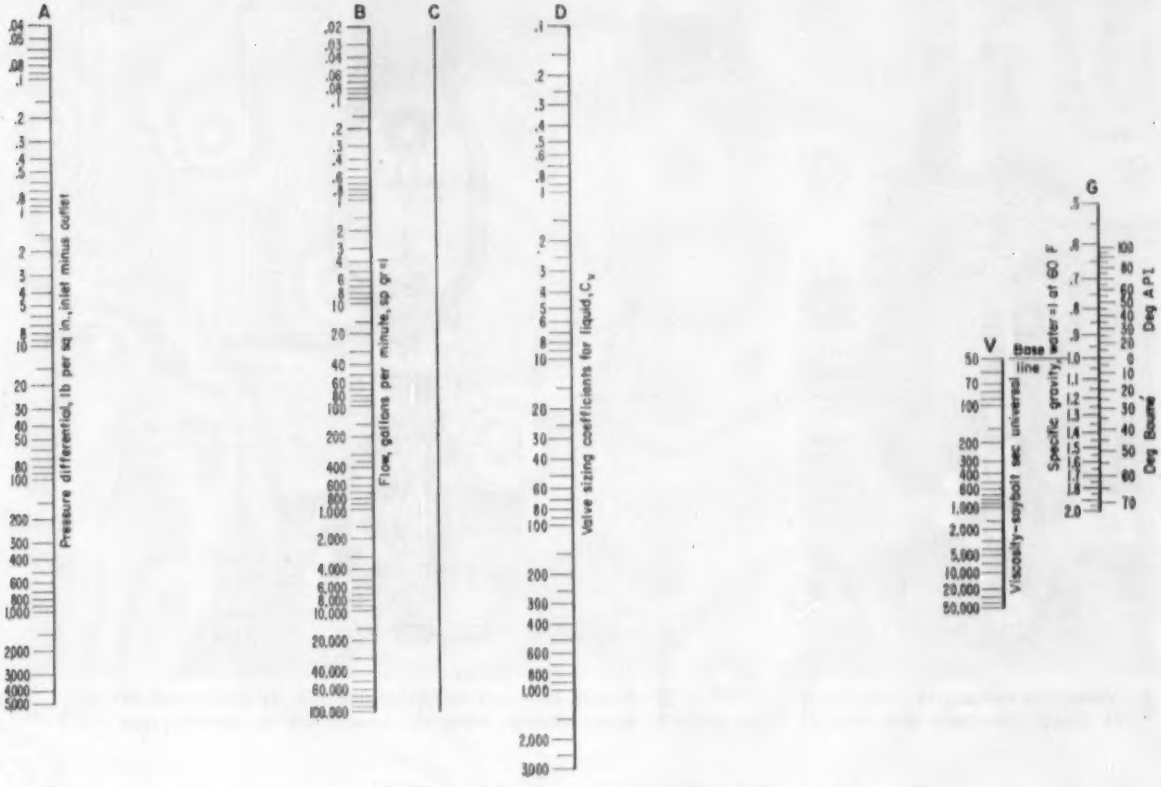
Major cause of hunting and cycling control valves is oversizing. Too-big control valve strokes only a small part of its available travel, to handle maximum and minimum flow requirements. Result: An unstable valve. With normal friction present, valve action is erratic—commonly called hunting or cycling. Also, oversized valves wear out rapidly because valve works very close to seat, eroding it—especially if pressure drop across the valve is high.

All control-valve manufacturers have alignment charts or slide rules for sizing diaphragm-control valves. Typical liquid-capacity chart, next page, shows how to size control valve for liquid flow.

2 Body pattern

Two most common body patterns are the double-port and single-port globe. In double-port design, the top port is usually equal, in diameter, to the nominal pipe size of the body. It's about ⅛ in. larger than the bottom port. Upper port is larger to simplify installing inner valve in the body. Big advantage of the double-port body: It needs a minimum of power from the diaphragm to position inner valve.

Referring to Fig. 1, inlet pressure acts on the top port, tending to open it. At the same time, inlet pressure tends to close the bottom port. So the unbalanced force across the double-port valve is equal to the port-area difference. For this 4-in. body, 0.77-sq-in. difference times the 80-psig pressure drop yields a 61-lb force acting to open



How to size the control valve

Most valve manufacturers use the C_v method for sizing control valves. C_v is the liquid-flow coefficient of a valve body. It's numerically equal to the water gpm that a valve can pass with 1 psi pressure drop.

For the engineer or valve manufacturer to correctly size the valve he must know: (1) inlet and outlet pressures across valve, (2) kind of fluid, its temperature and gravity, (3) required flow. Units—gas, cubic ft per hr; steam, lb per hr; liquid, gpm.

If the liquid's specific gravity is other than 1.0, correct the given flow rate to the equivalent water flow: (1) Lay a straightedge on flow rate (scale *B*) and the specific gravity of the liquid (scale *G*). Mark the point of intersection with line *C*. (2) Pivot straightedge at intersection point on line *C* to sp gr 1.0 on scale *G*. Read the corrected flow rate on scale *B*.

If liquid has a sp gr of 1.0, locate flow directly on scale *B*.

If liquid's viscosity is greater than 50 Saybolt Seconds Universal: (1) Lay the straightedge on the flow rate, corrected for sp gr, (scale *B*) and the viscosity of the liquid, in ssu, (scale *V*). Mark point of intersection with line *C*. (2) Pivot the straightedge at point of intersection with line *C* to the base line (viscosity 50 ssu) on scale *V* and read the corrected flow rate on scale *B*. Omit these two steps if viscosity doesn't enter the sizing problem.

Lay the straightedge on the pressure drop (scale *A*) and the corrected flow rate (scale *B*). Read the valve sizing coefficient, C_v, on scale *D*.

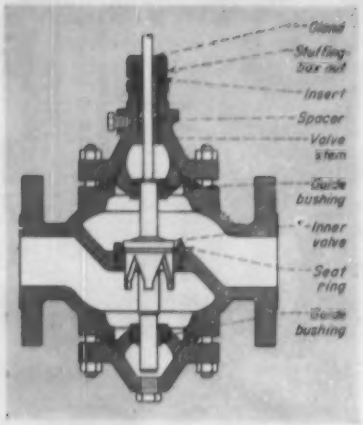
Knowing the required coefficient, it's only a matter of selecting the smallest valve size that can pass or exceed this flow. Flow-coefficient tables for various-size valve bodies and inner-valve styles are available from valve makers.

---

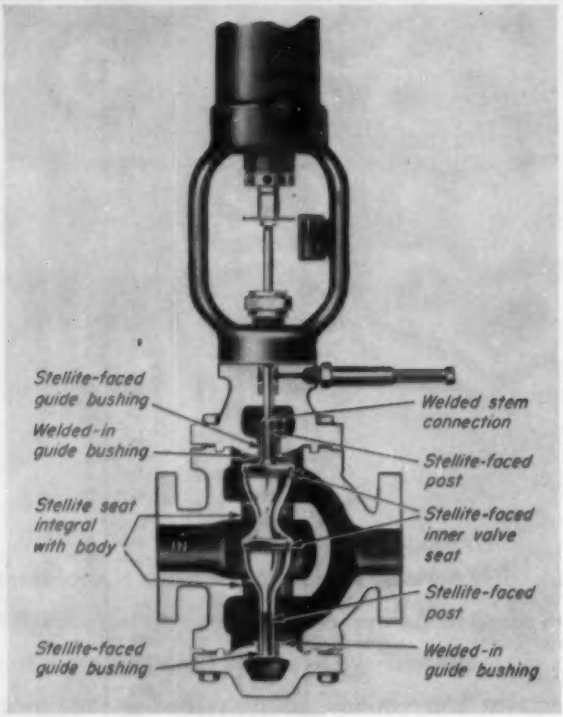
the valve. This unbalance is easily overcome by the standard diaphragm operator, allowing it to position the valve as dictated by the controller.

Shortcoming of the double-port body: It can't be counted on to shut off tight. Thermal-expansion-coefficient difference between inner valve and body material, as well as pressure and bolting stresses, makes it virtually impossible to get tight shutoff. If your job can't tolerate leakage up to 2% of maximum valve capacity, don't choose a metal-to-metal seated double-port body.

If you need tight closure, use single-seat valves. But figure on overcoming an unbalanced force equal to the port area times pressure drop across the valve. Fig. 2 shows a 4-in. single-port valve with 12.5-in. port area. A 100-psi pressure drop across the valve produces a 1256-lb unbalanced force acting to open the valve. So the valve needs a bigger, more expensive operator than would be used on a double-port body of the same size. And an auxiliary relay—a valve positioner—would probably be needed to feed more air to the diaphragm to overcome spring compression and close the valve. Un-



4 Valve trim comes in a wide variety of alloys. Most are 316 stainless



5 Double port with integral-stellite seat is often used on heater drains. Parabolic inner valve is versatile type

Control valves come in a wide variety of types, some with

balanced-force problem becomes especially important where large valve sizes must operate under high pressure drop conditions.

Important point: When installing a single-port valve make sure flow acts to open (rather than close) the inner valve. Chance of slamming or chattering as valve approaches the seat is thus eliminated.

Where you're going to need absolutely tight shutoff—and valve size, pressure make single-port design impractical—consider a double-port body with O-ring seats. But these are limited to 150-F service temperature.

Angle bodies, Fig. 3, get occasional use on heater drainers. Purpose is to pass the erosive-corrosive fluid out of the body quickly. But a chrome-alloy globe body, such as ASTM Grade C-5, will withstand the *condensate-washout* effect that sometimes develops in carbon-steel globe bodies causing holes and pitting. Since C-5 globe bodies don't cost any more than steel-angle bodies, trend has been to chrome-alloy globe bodies for drainer service. For some jobs angle bodies prove unstable, even cause slamming, pipe hammer. Because the valve is single port, flow entering the side tends to close it as it approaches orifice seat.

Other body patterns for specialized applications include the Saunders patent valve and butterfly valve with diaphragm operator.

3 Body and trim material

Most control-valve bodies are either cast high-tensile iron or cast carbon steel. Cast iron is limited by ASA code to 250 psi, 410 F, and 400 psi, 100 F. Cast carbon steel handles pressures up to 6000 psi and temperatures to 850 F.

For higher temperatures, a molybdenum bearing alloy, like ASTM Grade WC1 or C5, gets the nod. Other valve body materials—for handling corrosive fluids—include stainless steel, nickel bearing alloys and other castable alloys.

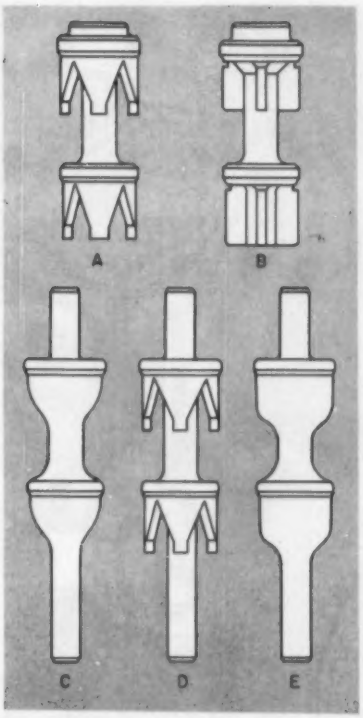
End connections depend on service conditions. Valve sizes to 2 in. are usually screwed. Larger sizes take flanged-end connections. Welding ends are generally specified for high-pressure high-temperature jobs.

When we speak of valve trim, Fig. 4, we mean the inner valve, seat rings, valve stem, guide bushings and stuffing-box parts. And while most manufacturers offer a wide variety of alloys for these parts, most valves come with AISI type-316 stainless steel—except for guide bushings. These are made of different hardness material to avoid galling, seizing. Type-416 stainless, hardened to 37 to 43 Rockwell C, is widely used here. Also, an age-hardening nickel-bearing stainless—stainless W—finds use for guide bushings where corrosion resistance is important.

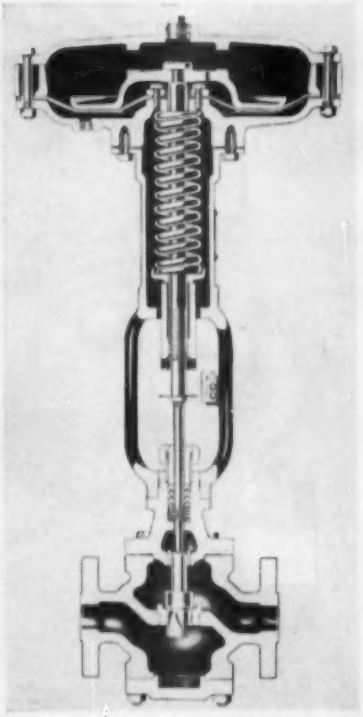
If your job calls for a pressure drop greater than 150 psi, a hard-surface material, such as stellite or Colmonoy applied to valve seats, can pay for itself in a short time by reducing maintenance. For high-temperature service (above 700 F) it's smart to specify hard surfacing on the guide bushings and valve posts, to resist galling.

When choosing a valve to handle flashing condensate, consider stellite on seats, posts and guides.

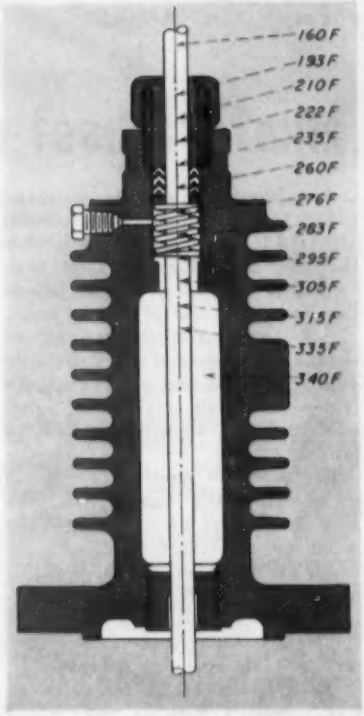
High-pressure steam-control valves need seal-welded seat rings or integral stellite laid in the body—instead of seat rings. Purpose is to eliminate leakage around threads between body and ring, due to unequal thermal expan-



6 *A and B are skirt-guided. C, D and E are top-and-bottom-guided valves*



7 Small valves don't yield large unbalanced forces, can be single port



8 Cooling fin reduces temperatures around stuffing box. Body is 725 F

special features to meet the needs of specific jobs

sion. Fig. 5 shows body and trim construction often used on heater drains —especially when the valve is installed after a heater drain pump. Hard surfacing on posts and guides reduces wear caused by pump's vibrational effect.

4 Inner-valve style

Basic types of inner-valve characteristics are: (1) linear (2) percentage type. Where major part of pressure drop at maximum flow is absorbed by the system itself, percentage type works out better. If pressure drop is substantially constant as load varies, the linear characteristic will probably do a better job. But both types are used on flow, liquid level, pressure and temperature controls. And both are doing a good job. So selection isn't critical.

Most important factors in choosing inner-valve style are guiding and shape. Inner valves, Fig. 6, *A* and *B*, are skirt-guided. Type *B* is quick-opening style for on-off service. Type *A* is skirt-guided V port for throttling control and light service. Skirt guides are lower cost than top-and-bottom-guided inner valves, Fig. 6, *C, D, E*. But they're limited to service where pressure drop across valve is not more than 75 psi.

Better, but more expensive, is top-and-bottom-guided type. Use these on high-pressure and high-temperature jobs and where condensate may flash across the valve.

Small valves often come furnished with single-port fluted inner valves, Fig. 7. Most companies offer this type only up to 1 in.—to avoid large unbalanced force in larger sizes.

Either V-notch valve, Fig. 4, or machined-contour type, Fig. 5, does a good job for most applications. But the machined-contour (parabolic) type gets the nod where the fluid has suspended solids that may harm inner valve.

5 Stuffing box

Maintenance men often consider control valve's stuffing box a main trouble source. For years, graphited asbestos packing with a lubricator was used. Main objection to this type was its need for frequent attention, frictional resistance to stem movement.

Plastic packing—*Teflon*—is now standard with most manufacturers. *Teflon* is impervious to all chemicals except molten sodium, has a wide temperature range—plus 500 to minus 200 F. It's available preformed as a V ring, shredded or *Teflon*-impregnated asbestos. V-ring type needs a mirror-like finish on the stem to keep a good seal. Also, you'll have to exercise care to protect the stem surface that slides into the packing from being scratched or scored.

Important: When service temperature is over 450 F, specify a cooling fin, Fig. 8. It protects the stuffing-box packing against too high temperature. Fins can cool to fluid's saturation temperature at operating pressure. In dealing with superheated steam above 650 psig, you'll do well to order a cooling fin with metallic packing.

For very low temperatures a plain extension head makes the stuffing box accessible outside the installation. Steam-tracing the extension keeps frost away, avoiding a troublesome valve.

6 Diaphragm operator

Most common operator is a flexible diaphragm of 1/16-in. neoprene with one ply of cotton duck or nylon insert. Steel spring opposes the diaphragm. Spring is sized so valve strokes fully

over a 3-to-15-psig air-pressure range.

Fig. 9, left, shows body assembly arranged for air or diaphragm to close the valve. Body, Fig. 9, at right, is reversed, so valve closes on air failure. Diaphragm can also be reverse acting, Fig. 7. Here, air applies pressure under the diaphragm and spring closes the valve. Reverse-acting operator usually comes with small single-seated valves where close-on-air-failure action is needed.

Key points to specify: (1) Output pressure from the controller—3 to 15, 5 to 20, or 3 to 27 psig. (2) Valve action on air failure. Difference between the two types, Fig. 9, is only a matter of assembly. You can change the action without additional parts. But right assembly at the factory saves time, possible operating difficulties.

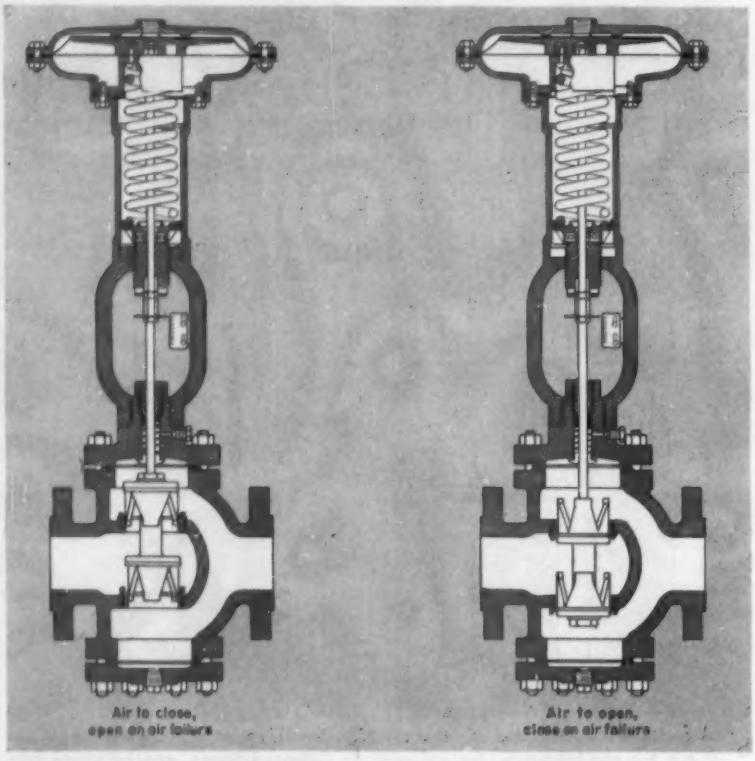
Diaphragm operator translates air signal—usually 3 to 15 psig—into a uniform, linear valve motion. At 3 psig, valve should be fully open. At 9 psig, valve is in mid-position. And at 15 psig, valve is fully closed.

Excessive friction or unbalanced forces (from single-port valves, for instance) can destroy the linear relation. For such conditions a power relay—commonly called a valve positioner—is sometimes called for.

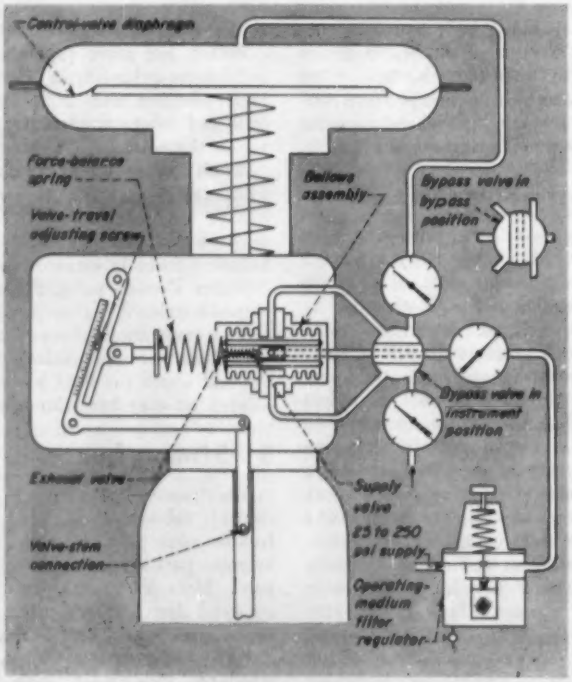
One type of valve positioner, Fig. 10, uses a separate air supply to get more stroking power. Instrument pressure boost is reflected in the bellows assembly, increasing pressure on main valve's diaphragm. If valve doesn't move the correct distance, positioner applies more pressure on the diaphragm, up to maximum air-supply pressure, or until valve moves to correct position. Bellows assembly is then restored to balance.

Positioner assures exact valve response to controller signals—eliminating friction and operator hysteresis. You'll often find positioners on single-port valves 4 in. and larger. Also, where extremely close control is a must and system has substantial time lag (sometimes found in temperature controls), positioner gives faster valve response.

Other positioner application: Where you want different pressure range on diaphragm than instrument transmits. Typical situation is split range—where one instrument in a system operates two diaphragm control valves.



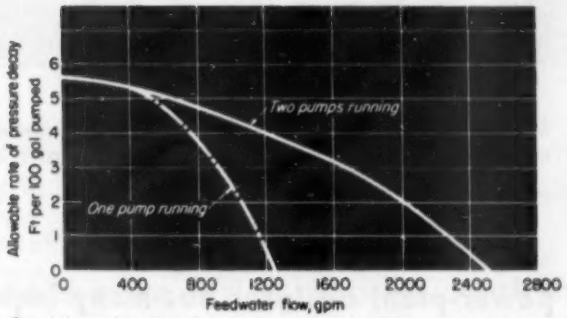
9 Valve action on air failure depends on how inner valve is assembled. Action can be changed from close on air failure to open on air failure, in the field



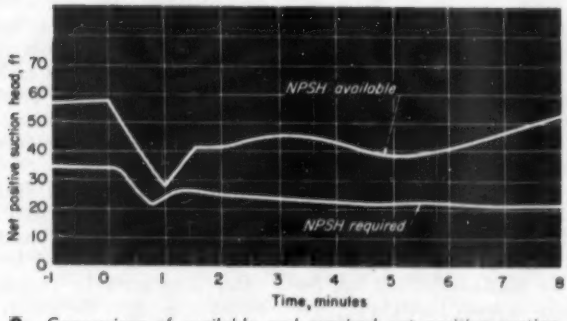
10 Valve positioner uses a separate air supply to get more stroking power. Used where big unbalanced force exists

Designing for load drop in open feed systems

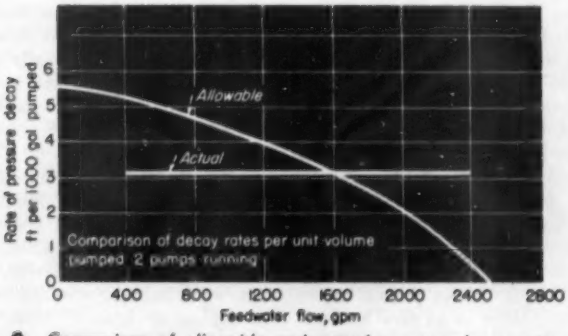
By **IGOR KARASSIK**, *Manager, Multistage Pump Section, Worthington Corp,*
G H BOSWORTH, *Senior Engineer, Bechtel Corp, and*
WARREN ELSTON, *Assistant Engineer, Pacific Gas and Electric Co*



1 Allowable rate of pressure decay in direct-contact heater per unit of volume of feedwater handled by the feed pump



2 Comparison of available and required net positive suction head existing during transient conditions in the station


Rate of pressure decay
ft per 1000 gal pumped
Allowable
Actual
Comparison of decay rates per unit volume pumped 2 pumps running
Feedwater flow, gpm

3 Comparison of allowable and actual pressure-decay rates in the system analyzed in the text of this article series

► MANY FORMULAS have been developed to calculate the actual rate of pressure decay. Some are simple, others complex. These will not be discussed here—only important factors relating to assumptions made in predicting the actual rate of pressure decay in a direct-contact heater. See Part 1, Oct POWER, pp 96-97.

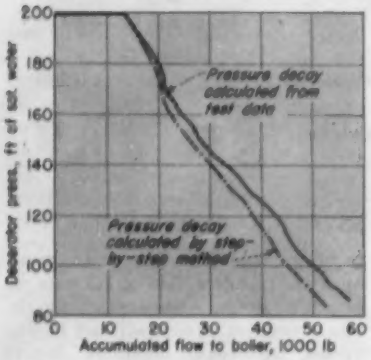
Feedwater flow from the heater and condensate flow to the heater are both subject to much fluctuation during transient conditions. Separate controls cause the fluctuations, which do not always coincide. Both flows affect the actual decay rate.

Assuming the two flows are always equal and the quantity in storage remains constant can sometimes lead to serious errors. Also, several control systems exist for condensate and make-up admission to the heater. Each has widely different effects on the inlet-flow rate during transient conditions.

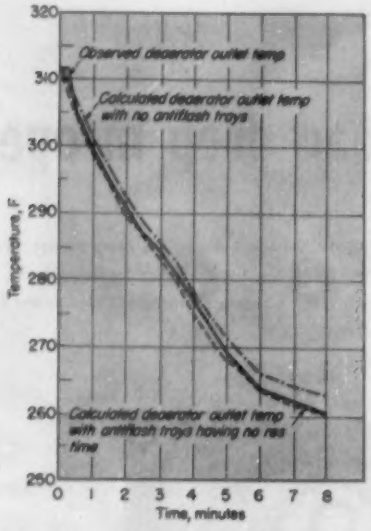
Two control systems used are: (1) Heater level controls a throttling valve in the condensate admission line. (2) Main condensate flow is uncontrolled, but floats make up or bypass condensate, as needed. In the second system condensate admission closely follows steam flow. Regulation of water level within close limits is possible with float-controlled valves, but close regulation here is unnecessary and may be harmful.

Simplification. Better results are secured if, instead of determining the actual pressure-decay rate in feet per minute for one given flow, we express this rate in terms of volume pumped for the entire range of pump flows. We can then compare this rate with the allowable decay rate to establish the maximum flow for any given load drop, below which the allowable rate exceeds the actual, making the installation safe. Fig. 1 shows the results of calculations for the installation described last month, pp 96-97. Tests by the authors verify the actual decay.

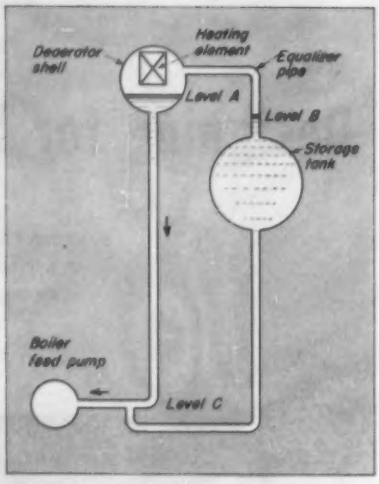
Using certain assumptions, it is pos-



4 Observed rate of pressure decay vs cumulative feedwater flow in plant



5 Effect of antiflash baffling on the outlet temperature of feed heater



6 Piping hookup of a two-tank deaerator system is discussed in the text

sible to develop a simple algebraic expression for the rate of heater pressure decay in terms of flow from it. From this expression the actual decay rate per gallon pumped vs pump flow is plotted for any chosen load reduction. This curve can be superimposed on the curve of allowable decay rate to show the range of pump flows safe during the transition period for that particular load drop.

Fig. 4 shows observed rate of pressure decay vs cumulative feed flow. Available net positive suction head (npsh), Fig. 2, was calculated by subtracting vapor pressure corresponding to the temperature at the pump suction from the measured suction pressure corrected to the pump center line. The most critical period occurs exactly at the end of the residence time in the suction piping. Margin of available npsh over required npsh was reduced from about 22 ft to less than 4, showing the dangers incurred during transient conditions.

Fig. 3 compares actual and allowable rates. For the load drop in the test all flows below 1600 gpm (total of two pumps) result in safe conditions. Flows above 1600 gpm give actual decay rate exceeding the allowable.

Protective measures. To improve suction conditions during a load drop the designer can elevate the deaerator, lower the feed pumps, or size the connecting piping for as small a diameter as possible while using the most direct route for the piping.

First method has limitations. Second is contrary to popular practice, which provides large-diameter suction pipes to minimize friction, without considering residence time.

The power-plant designer has many important

Where characteristics of the feed system cannot be changed, protective measures include: (1) increasing heater storage to diminish actual decay rate (2) antiflash baffling in heater (3) 2-tank system with cold-water storage floating on pump suction (4) protective controls.

Increasing heater storage diminishes the actual pressure-decay rate. Cost is unattractive except in a few plants. In recent years antiflash baffling has become popular in many plants to improve feed-pump suction conditions. Baffling conducts water direct from heating and deaerating element to outlet of the heater. Fig. 5 shows effect of antiflash baffling on the plant considered here.

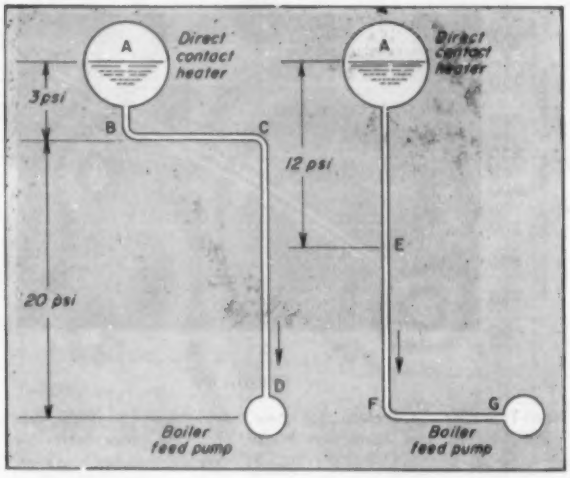
The 2-tank system, Fig. 6, has not gained as wide recognition as baffling. Storage tank, mounted lower than the heater, connects to the suction line at a point near the feed pump. Tank should not be insulated so water in it cools to near the ambient temperature. Equalizer pipe connects tank top to heater steam space.

Difference in the specific gravities of water in the two columns makes level *A* higher than *B*. While normal conditions prevail, there is no flow between storage tank and feed pump. When heater pressure suddenly drops, water tends to flash in heater and in suction pipe between *A* and *C*, Fig. 6. As soon as flash takes place in this line, specific gravity of the mixture in it is greatly reduced. System becomes unbalanced and water from storage tank flows direct to the feed pump, providing cold water at pump suction and removing danger of flashing under transient conditions.

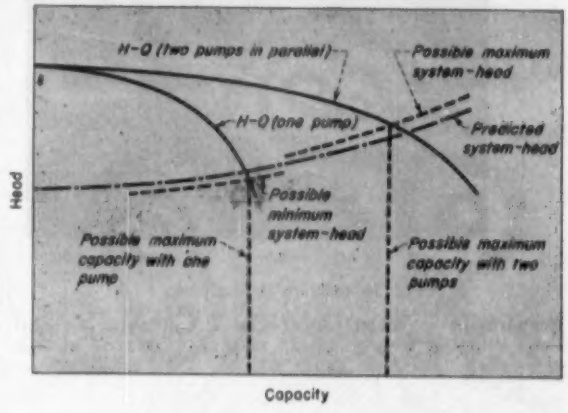
Since flashing in the direct suction line is necessary for this system to work, piping from the heater to the point where it is joined by the cold-water pipe must be routed to allow return of vapor to the heater. It should be sized large to increase residence time, thereby encouraging flashing.

Water-storage volume in heater and tank must be carefully coordinated, as well as relative friction losses in the two lines down to the point where they join. It is also extremely important that piping beyond this point be so routed and sized as to preclude any flashing.

A serious problem of the 2-tank heater system: Protection against loss of npsh during load fluctuations is achieved at the cost of producing sufficient flashing in the main suction line. This flashing may be severe, introducing water-hammer conditions harmful to piping or heater. Also, a serious load drop permits the feed pumps to draw on the cold-water tank for an ex-



7 Comparison of suction-pipe arrangements for two systems. Flashing will occur in the system shown at the left above



8 Analysis of the maximum flow in a two-pump installation for boiler feeding. Note the points of intersection here

decisions to make during the planning of feed-system arrangement

tended period. Cold water is ultimately replaced by feedwater at an elevated temperature. If the first load drop is followed by another before water in the tank is reduced in temperature, the installation is no longer protected.

Antiflash controls. Two methods of control are: (1) Increase or maintain minimum suction pressure for a given vapor pressure by using an auxiliary steam source. (2) Reduce vapor pressure at pump suction, using cold water injected into a convenient point of the suction line. Impulse for either may be a safe rate of pressure decay or available npsh. Semiautomatic control is possible.

Suction piping. Criterion for determining probability of flashing in the suction piping is to consider that water leaving the heater outlet in a saturated condition must gain static pressure, because of the vertical drop, at a rate at least equal to the pressure-decay rate of the heater, or it will flash. The most adverse conditions are caused by locating a horizontal run too close to the heater outlet. Fig. 7 shows a typical case. In comparing these two installations we'll assume that total length of piping and pipe sizes are the same for both, and that the piping volumes between the heater outlet and points *C* and *E* are also equal.

With initial heater pressure of 52 psig and temperature of 300 F, flashing occurs at *C* if at any later time, say *x* seconds, the heater pressure falls to 48 psig and corresponding temperature to 296 F. This occurs because pressure at *C* is 51 psig, temperature 300 F. No flashing occurs at point *E* because temperature is 300 F, pressure 60 psig.

If actual pressure-decay rate per gallon of feedwater pumped is calculated for any given load drop, it can be compared to the allowable rate for any critical point in the suction piping. Relative safety of the suction piping layout can be determined without estimating the possible behavior of feed flow after load drop.

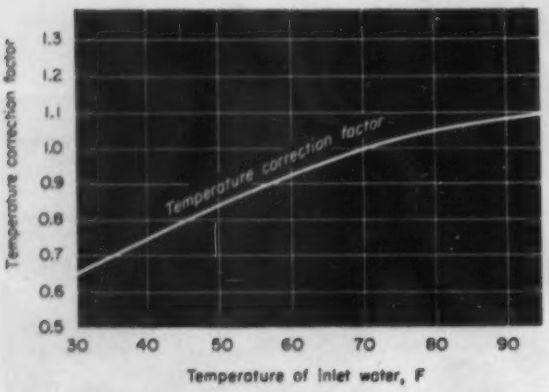
Sudden load increase. Analysis of this condition in open feed systems is considerably less complex than sudden load drop. The time lag now operates in favor of the system. But we must consider the case of two half-capacity pumps, normally operating in parallel.

Because serious errors may result from oversimplifying the problem of choosing single or multiple pumps, two entirely different approaches are recommended in plotting system-head curves for pump operation. Curve for multiple-pump operation should be plotted from a pessimistic approach to insure meeting maximum demand. For single-pump operation, predictions should be on the low side to show maximum capacity at which the intersection between head-capacity and system-head curve could take place, as shown in Fig. 8.

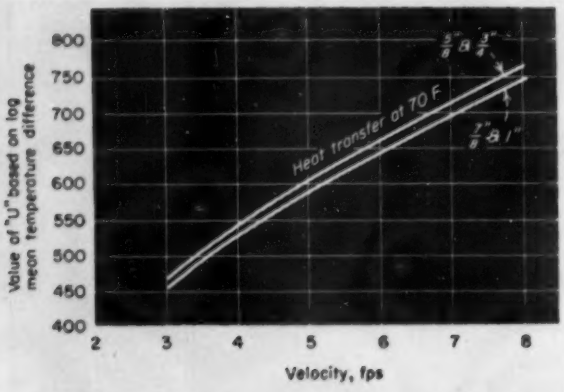
The exact amount of additive npsh provided by the time lag between the increase in heater pressure and the arrival of higher-temperature water at the pump suction is easily calculated. It equals the difference between the vapor pressure in the heater at the new load and the vapor pressure previous to the load change. This leeway, available before serious trouble occurs, is normally sufficient to allow operators to put the second pump on the line and reduce the individual pump flow to a value where the npsh is adequate. But a careful check of conditions prevailing after a sudden load increase has taken place should be made for available npsh and load on the driver.

One way to prevent sudden load increase from introducing any hazard for suction pressure or driver overload uses a pressure switch in the discharge header. Switch is set so it starts a second pump whenever header pressure falls below a predetermined minimum. Capacity that introduces npsh or overload hazards dictates the minimum pressure chosen. Justifying such a protective control must be left to the power-plant designer.

Next month the final article in this series will discuss closed cycles and problems common to both open and closed cycles



Temperature correction factor modifies coefficient *U* (right) when condenser cooling water is under or over 70 F at inlet



Heat-Transfer coefficient for new, oxidefree 18 BWG admiralty tubes. Use correction factor* for any other materials

Figuring the size of condenser heat-transfer surfaces need no longer be a long, tedious procedure. Now you can eliminate trial and error calculations with this . . .

Handy way to size surface condensers

By J T FONG, *Foster Wheeler Corporation*

► THE METHOD of finding size of heat-transfer surface for surface condensers should be fast and accurate. But up to now many proposed designs were checked by trial and error. New calculations were needed for every change involving tube lengths and passes, water velocities or design pressures.

Now, however, an engineer can avoid much hard work by using the condenser-sizing chart on facing page. Once he is familiar with the units and terms involved, he can calculate, in just about one minute, condenser surface and quantity of circulating cooling water required.

While simple, this solution is exact. No approximations or assumptions were made in deriving the basic equation for the chart (see derivation below).

The only rule to observe—and this applies to any method of sizing condensers—is that manufacturers are reluctant to guarantee performances where terminal temperature difference (difference between inlet steam temperature and outlet circulating-water temperature) is less than 5 F.

Here's an example of how the new chart works. Find the condenser surface and quantity of cooling water required for a single-pass condenser with the following conditions: ⅞-in. OD, 18 BWG 25-ft-long admiralty tubes; cleanliness factor 85%; backpressure, 2 in.; cooling water, 60 F; velocity, 6 fps. Maximum steam flow to condenser, 200,000 lb per hr at 950-Btu-per-lb heat rejection.

Solution (see facing page for symbol definitions):

Heat-transfer coefficient (from charts at top of this page)

$$U = 645 \times 0.92 = 593$$

$$P = \frac{NLFUC_c}{1560\ V} = \frac{1 \times 25 \times 0.483 \times 593 \times .85}{1560 \times 6} = 0.65$$

$$t_v - t_1 = 101.14 - 60 = 41.14$$

$t_2 - t_1 = 19.7$ (from condenser-sizing chart)

Cooling water, gpm =

$$\frac{\text{Maximum steam flow to condenser} \times \text{Btu/lb heat rejection}}{500\ (t_2 - t_1)} = \frac{200{,}000 \times 950}{500 \times 19.7} = 19{,}300$$

$$\text{Condenser-surface area } A, \text{ sq ft} = \frac{500 \times \text{gpm} \times P}{U \times C_c} = \frac{500 \times 19{,}300 \times 0.65}{593 \times 0.85} = 12{,}430$$

When figuring performance, observe limits of absolute pressures at low loads caused by air-removal equipment limitations. Heat Exchange Institute Standards have such curves.

Derivation. Here's how the sizing chart and the equations used in solution above are derived:

1. $q = U'A\,\Delta t_m$
2. $\Delta t_m = (t_2 - t_1) \div \left[\ln \frac{(t_v - t_1)}{(t_v - t_2)}\right] =$
3. $A = nLa$

*Charts based on Standards of Heat Exchange Institute, third edition. Table, p 2 of this edition, gives correction factors. Booklet available at $2 per copy from Heat Exchange Institute, 122 E 42nd St, New York 17, N. Y.

Nomenclature

A—Condenser surface, sq ft

a—Outside surface of each tube, sq ft per ft of length

a_x—Internal cross-sectional area each tube, sq in.

C_c—Cleanliness factor

c_p—Specific heat of water at constant pressure, Btu per lb, F

F—Tube constant, $a \div a_x$

L—Tube length, ft

N—Number of tube passes

n—Total number of tubes

P—Parameter, influencing condenser sizes, dimensionless

q—Heat transferred in condenser, Btu per hr

t_1—Cooling-water inlet, F

t_2—Cooling-water outlet, F

t_v—Condensing temperature (saturated-steam temp) determined from backpressure desired, F

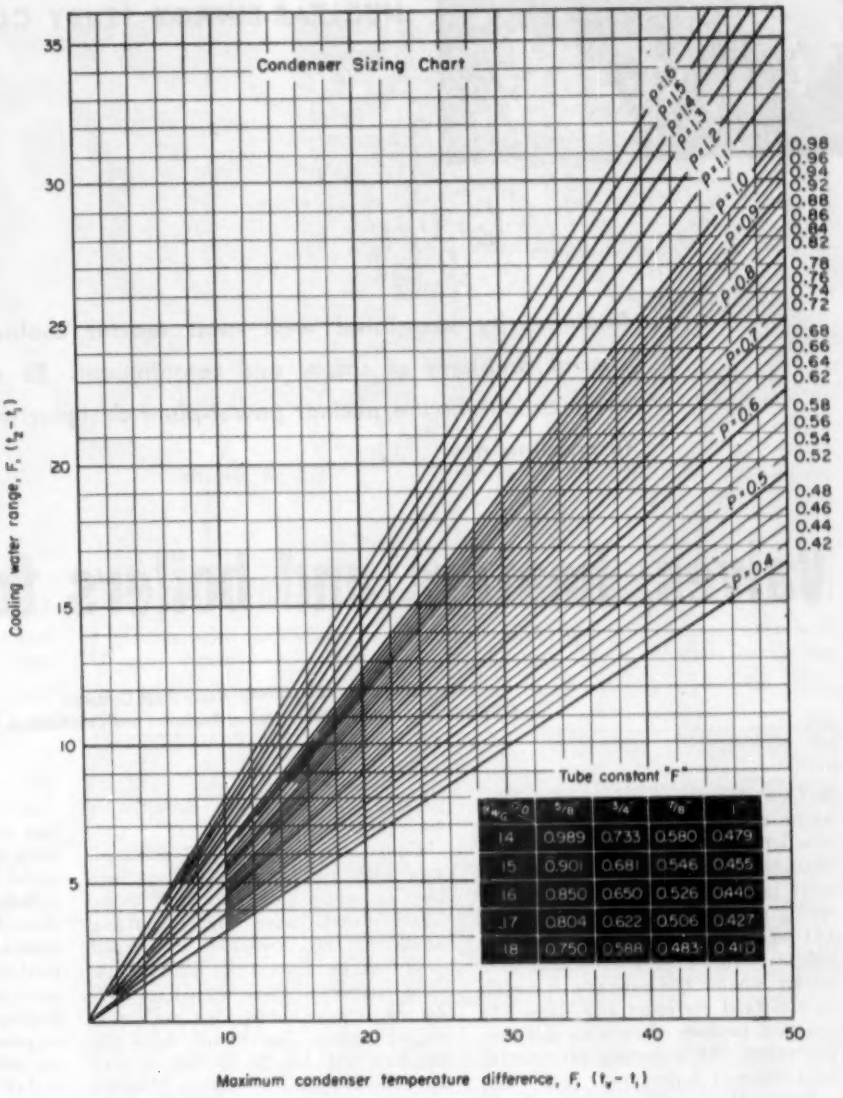
Δt_m—Logarithmic mean terminal temperature difference

U—Over-all heat-transfer co-efficient without cleaniness factor, Btu per hr per sq ft per degree F

V—Design cooling-water velocity, ft per sec

w—Cooling-water flow rate, lb per hr

U'—Over-all heat-transfer coefficient corrected for cleanliness factor, Btu per hr per sq ft per degree, F. ($U' = C_c\ U$)



$t_2 - t_1$	5/8"	3/4"	7/8"	1"
14	0.989	0.733	0.580	0.479
15	0.901	0.681	0.546	0.455
16	0.850	0.650	0.526	0.440
17	0.804	0.622	0.506	0.427
18	0.750	0.588	0.483	0.410

4. $q = w\ c_p\ (t_2 - t_1)$

5. $V = wN \div 1560n\ a_x$

Substitute equations (2) and (3) into (1), and (5) into (4), then equate (1) and 4):

6. $(U'nLa) \times (t_2 - t_1) \div \left[\ln \dfrac{(t_v - t_1)}{(t_v - t_2)}\right] =$

$(1560n\ V\ a_x \div N) \times c_p\ (t_2 - t_1)$

Since $c_p = 1$, by substituting and simplifying we have:

7. $\ln \dfrac{(t_v - t_1)}{(t_v - t_2)} = (NLU'a) \div (1560V\ a_x)$

Letting $a \div a_x = F$, and
$NLU'F \div 1560V = P$, a dimensionless parameter,

8. $(t_v - t_1) \div (t_v - t_2) = e^P$

Further simplifying, we obtain

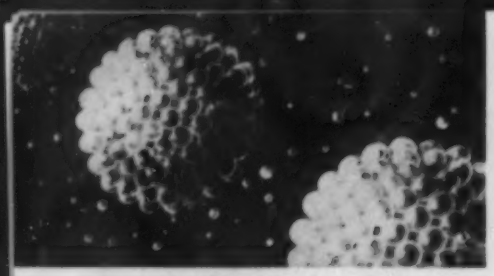
9. $(t_2 - t_1) = [1 - (1 \div e^P)] \times (t_v - t_1)$

So we can design a chart by plotting $(t_2 - t_1)$ vs $(t_v - t_1)$ with P as the varying parameter. This results in a family of curves.

From equation (4):

10. Cooling water, gpm $= w \div 500$
$= q \div [500c_p\ (t_2 - t_1)]$

11. Condenser surface $A = q \div (U'\Delta t_m)$
$= [w\ c_p\ (t_2 - t_1)] \div (U'\Delta t_m)$
$= wP \div U'$, since $c_p = 1$



Radioactivity associated with most reactor coolants raises special problems of safety and containment. To cope with these conditions the nuclear power-plant designer must resort to creating new . . .

Valves, heaters and boilers for reactors

By HENRY C SCHWENK, *Henry Pratt Company*
and ROBERT H SHANNON, *United Engineers and Constructors, Inc*

► LAST MONTH we finished talking about pumps for coolant circuits, so now let's move on to valves, heat exchangers and boilers. Valves have to meet conditions similar to those governing pump selection. There must be: (1) no stem leakage (2) maximum reliability because of limited accessibility for repairs (3) adequate materials to withstand corrosion and stress (4) practical methods of opening and closing valves (5) a variety of types to meet different duties.

Radioactive coolant systems should use a minimum number of valves. This depends on the number of coolant systems, type of coolant, safety requirements, radioactivity level in areas where valves work. Isolating valves, normally opened or closed during operation, should give least trouble.

Stem seal arrangements include: (1) conventional gland seals with packing material (2) frozen seals for coolants with high melting temperatures—like frozen shaft seals for pumps (3) leakproof bellows (4) piston-actuated valves with an integral fluid controlling the system—all sealwelded.

Conventional packed valves do not meet the working conditions of coolant systems. These valves need regular maintenance and replacement of packing to limit leakage. Packing materials do not stand up under continuous exposure to liquid metals. Organic packing materials break down under nuclear radiations.

Frozen-stem seals are limited to coolants with high melting temperatures like Na, which melts at 208 F. Some liquid metals have higher melting points, but the possibility of a small stem leakage still exists. With an ambient temperature low enough, a coolant temperature not too high and a stem sealing section far enough from the hot valve body and hot coolant, we may use extended surface (fins) to keep the coolant below its melting point in the seal. Using a separate cooling system for the seals may make the frozen stem seal impractical. Such a cooling fluid would be subject to the same limitations as pump-seal coolants (No. 14, POWER, Oct 1955, p 110).

The valve operator, such as an electric motor or air diaphragm, must develop the maximum sheer or torque needed to break loose the stem from the frozen coolant. Considerable work has been done in developing this idea.

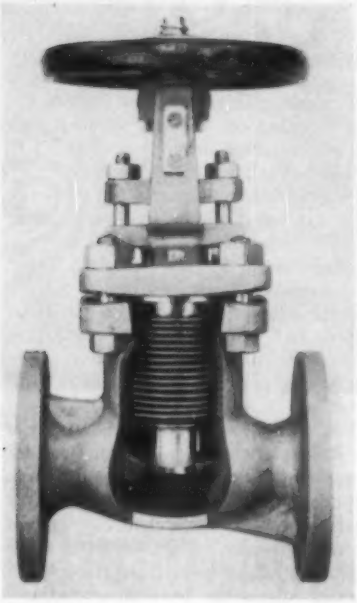
A plug-type valve with a frozen stem seal using toluene as a stem-seal coolant is proposed for the primary liquid-sodium coolant system of pilot and full-scale thermal-type reactor power plants. This valve type has been tested in a liquid-sodium system.

Bellows-sealed valves satisfy the "no stem leakage" condition. Considerable designing and testing have been done on various bellows in special test rigs and actual applications. This has been for pressurized-water and liquid-metal reactor systems.

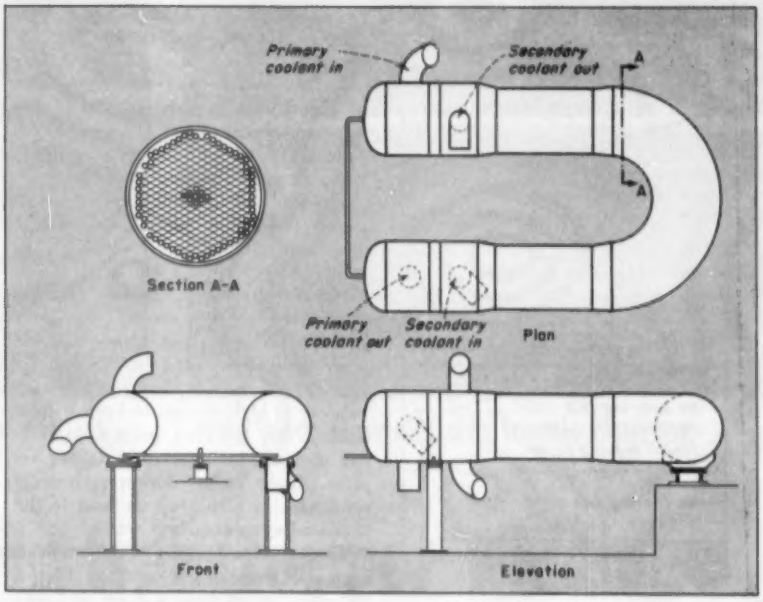
Bellows effectiveness depends on several factors: (1) method of forming convolutions (2) material used (3) total flexure between closed and open valve positions (4) vibrations set up by impingement of fluid against bellows or valve stem or by resonant frequency conditions depending on fluid velocity —these could cause fatigue failure of bellows. Bellows design, fabrication and stress calculations are moot points. Makers claim definite advantages for each bellows type.

Total bellows flexure should not exceed 15 to 20%—the former is preferred. Bellows may be protected against impingement by a sleeve or canning, or by properly designing the valve flow passages. Bellows should be checked to insure absence of vibration. Extensive and careful testing is needed to make the best choice of bellows-sealed valves for reactor systems.

Globe valves are best suited for bellows-stem seals. Gate valves need tremendously long bellows and over-all valve length to keep within allowable flexure limits. Fig. 1 shows a globe valve with bellows seal as made by the William Powell Co. This valve is the single bellows type. Two bellows in series or parallel insure leak tightness



1 Globe valve with bellows seal prevents fluid leakage along the stem



2 Liquid-metal intermediate heat exchanger (IHX) has both U-shaped shell and tubes that allow for expansion and contraction without expansion joint need

if one bellows fails. In some valves an inert gas fills the volume between the two bellows. When a bellows fails the pressure variation detects the breakage.

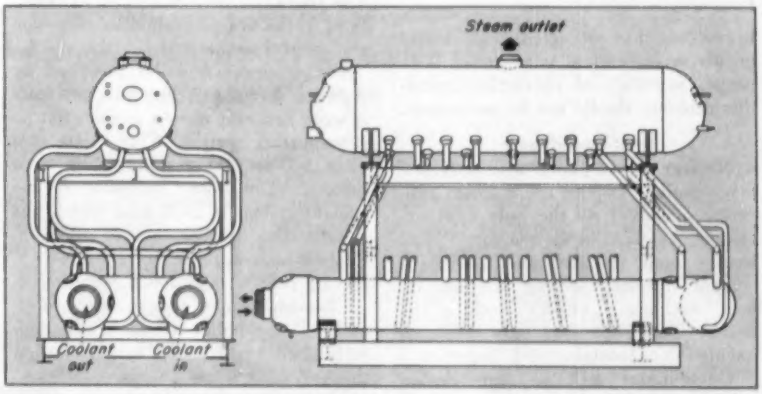
The valve disk should seat against the highest pressure. Then, if the bellows fails, the leak can be controlled by closing off the high-pressure source. Additionally, valve stem back-seating should be used to minimize leakage if the valve can be left only in the wide-open position when a bellows fails.

Piston-actuated valves meet the no-stem-leakage condition by using a fluid the same as the reactor coolant, or sometimes an inert gas. This requires an expensive auxiliary system for a large number of valves.

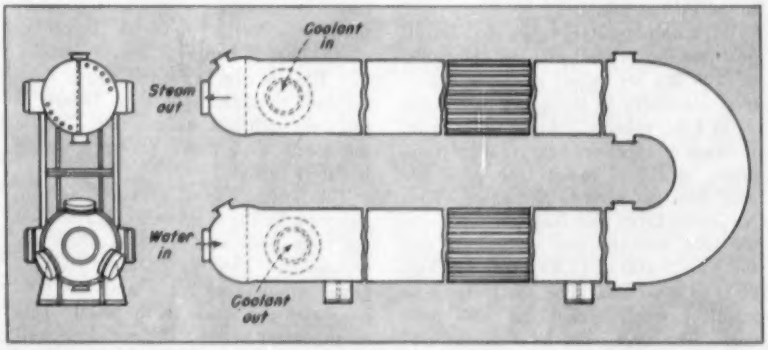
Valves for radioactive coolants must be remotely controlled or adequate shielding must be provided for local manual operation. Extension rods should be used to make valve operators (motors, diaphragms) accessible for repair. These rods and stems should also have a manual override control if automatic operating equipment fails.

Valve materials for all the parts must be compatible with the coolant, coolant-system material and reactor material (No. 13, Sept 1955, pp 98-100). Some satisfactory valve disk and seat materials are: (1) stellite or Colmonoy and surface-hardened stainless steels (2) stellite-to-stellite of different grades.

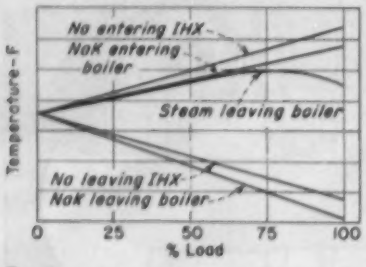
Some "diffusion welding" of metals



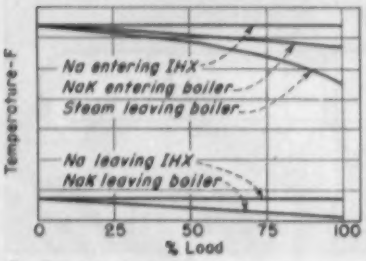
3 Natural-circulation boiler uses high-pressure water coolant as heat source for making steam in lower exchanger section, drum separates steam from water



4 Once-through boiler uses liquid-metal coolant as heat source—feedwater entering lower end evaporates to steam and may be superheated before leaving unit



5 Temperature changes, constant primary and secondary coolant flows



6 Temperature changes when both coolant flows vary with station load

in contact has occurred with liquid metals under certain conditions. With proper selection of contacting metals this problem should not be too serious.

Heat Exchangers

Nuclear power plants with only primary coolant systems use a steam generator or boiler as the only heat exchanger external to the reactor. Plants having both primary and secondary coolant systems need an intermediate heat exchanger (IHX) besides the boiler. These are used only in plants having liquid-metal-cooled reactors.

Liquid-metal IHX of one design (Babcock & Wilcox) is shown in Fig. 2. In this counterflow shell-and-tube unit the primary liquid-metal coolant flows through the tubes, and the secondary coolant through the shell surrounding the tubes.

With stainless-steel tubes the over-all heat-transfer coefficient runs about 800 to 1200 Btu per hr per sq ft per F with tube diameters ½ to ¾ in., tube pitch ¾ to 1 in., tube-wall thickness 1/16 in. Because of excellent heat-transfer properties of liquid metals the shell-side fluid does not need to be baffled. With Na inside tubes and NaK on shell side the film heat-transfer coefficients run for Na—10,000 to 11,000 Btu; for NaK 5000 to 6000 Btu. The shell would be stainless steel; nickel has also been used. The unit must have drains and vents. The U shape eliminates the need of expansion joints in shell and tubes. Expansion joints should be avoided for all liquid metal and radioactive systems.

Designs other than the one shown in Fig. 2 can be used for IHX. Designs are governed by: (1) thermal expansion (2) removal of reactor decay heat without pumping (3) flow arrangement of coolant system—completely pumped or partly pumped supplemented by gravity circulation (4) accessibility for tube bundle removal.

Natural-circulation boiler for the pressurized-water cooled reactor (PWR) takes its heat from the high-pressure water heated in the reactor. The pressure of the hot coolant (water) is high enough to keep it from boiling, but localized boiling may occur at local fuel hot spots in the reactor. Such steam, however, quickly condenses in giving up its heat to the surrounding pressurized water.

These boilers have (1) a feed-heating and evaporating section (2) a water-and-steam storage drum, and may have (3) a superheating section. The drum acts as a heat-storage unit and contains separators or scrubbers to remove entrained water from the steam. The feedwater may be treated externally or in the drum to minimize corrosion and control steam purity.

Fig. 3 shows a boiler designed by Babcock & Wilcox. The unit has feed-heating and evaporation sections but no superheating section. This boiler supplies 600-psig saturated steam to a turbine. The lowest pressure in the coolant system is 2000 psia, which has a saturation temperature of 635.8 F. Coolant temperatures run about 540 F, leaving reactor, and 500 F, entering it.

Choosing proper temperature differential in the boiler to obtain economically sized heat-transfer surface we get the relatively "low" steam conditions of 600-psig saturated for the PWR plant. The turbine may be troubled by excessive moisture in the last stages. To improve steam conditions, and possibly economy, one of these methods could be adopted: (1) Use separately fired superheater to raise steam to about 1000 F before it enters turbine. (2) Pass partly expanded steam from turbine through separator before it flows through last stages. (3) Throttle the steam to a lower pressure before it enters turbine.

The boiler, Fig. 3, also uses U construction in the heat-exchanger section for both shell and tubes to allow for expansion. The hp coolant (water) flows through the tubes and the 600-psi water and steam in the shell. This arrangement needs a thinner shell wall—lowering cost. Many down-comers and risers aid natural circulation.

In the once-through-boiler unit of a liquid-metal-cooled reactor plant the feedwater enters at one end of a continuous passage and leaves as steam at the outlet. This steam can be wet, dry or superheated. The unit does not have a steam-storage drum. Since the Na or NaK has relatively high film heat-transfer coefficient, the controlling resistance to heat transfer is on water side of the boiler or in tube material. Such a unit can be designed as a straight counterflow shell-and-tube exchanger.

Advantages of the once-through boiler compared to the circulation type are: (1) simplified design and fabrication (2) inherent compactness and lower cost.

In a liquid-metal-cooled thermal-type reactor plant the coolant can transfer heat directly to boiler water and steam, eliminating the secondary loop. This raises the hazard of a chemical reaction between water and the radioactive liquid-metal coolant. This possible reaction affects the problem of radioactive containment and exclusion area for this type plant.

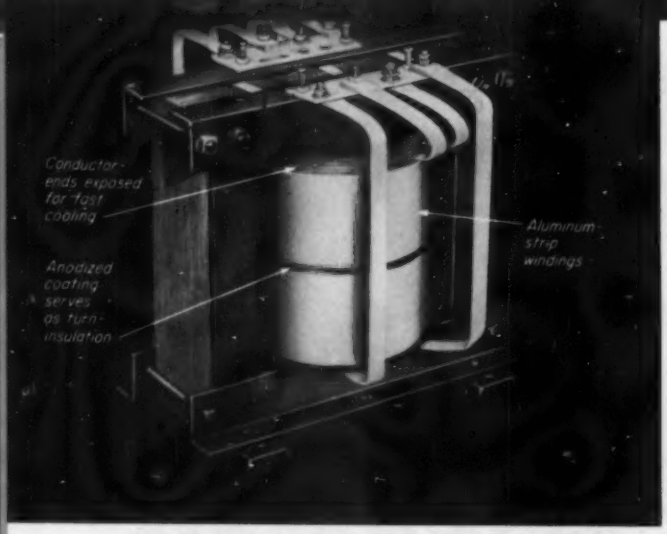
A liquid-metal-cooled fast-type reactor plant should definitely use a secondary liquid-metal coolant if steam is the working fluid. This insures against neutron-moderating elements like hydrogen getting into the primary coolant and causing a reactor runaway. The secondary liquid-metal coolant minimizes the containment-and-exclusion area problem and eliminates making the steam radioactive. Danger of a water-liquid metal reaction still exists, but shielding the secondary circuit near the reactor eliminates making the secondary coolant radioactive.

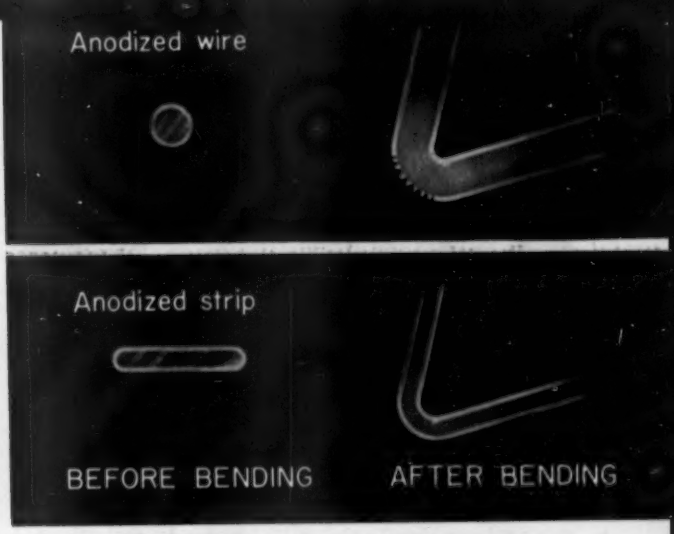
Double tube-wall. To minimize possibility of a water-liquid metal reaction in boilers, most of them are designed with double-tube-wall construction. This consists of two concentric tubes with the liquid metal on the shell side of the outer tube and the water and steam inside the inner tube, or the reverse. A third fluid in the space between the two tubes acts as a heat-transfer bond and helps detect leaks. The third fluid should be chemically inert to both water and liquid metal. By keeping the third fluid at a pressure lower than the steam but higher than the liquid metal (1) a steam leak in the boiler raises the third-fluid pressure (2) a liquid-metal leak lowers the third-fluid pressure.

Mercury and helium have been considered as the third fluid. But mercury has high toxicity, high surface tension (low wettability) and high cost.

Disadvantages of double-tube-wall units are (1) greater design and con-

(*Continued on page* 202)





Anodized coating of thin strips . . . may prove adequate insulation on . . .

Aluminum for transformer windings

- **By trimming insulation bulk, aluminum-strip windings, with anodic coatings as turn-to-turn insulation, look promising**
- **Right now transformer manufacturers are testing sample aluminum strips, but they're not ready to talk yet**

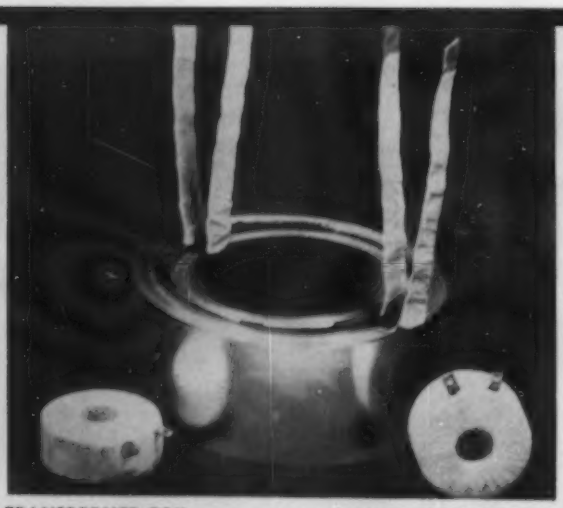
► IN MOST EQUIPMENT like transformers and solenoids where the space factor is important, the anodic coating on aluminum now promises to serve as insulation when strips of the lightweight metal are wound in coil form. This anodic coating is proposed as an insulation, replacing paper, glass or enamel normally used on wire coils. Spiral winding of coils subjects conductor insulation to the turn-voltage only. Major factors in coil compactness are (1) this space saving by using the extremely thin anodic film for insulation and (2) lack of voids in the completed windings.

Announcement of what may develop into a major step forward in electrical-equipment design was made recently by the Reynolds Metals Co. The anodic coating, consisting of aluminum oxide —a chemically inert material and an excellent electrical insulator—reduces the possibility of coils burning out since melting point of the anodic coating is reported higher than aluminum itself. Further space savings come into the picture since every coil turn is exposed to the outside, reducing the need for cooling ducts. Fins may be incorporated in the coils, providing additional cooling if wanted, without materially increasing their size.

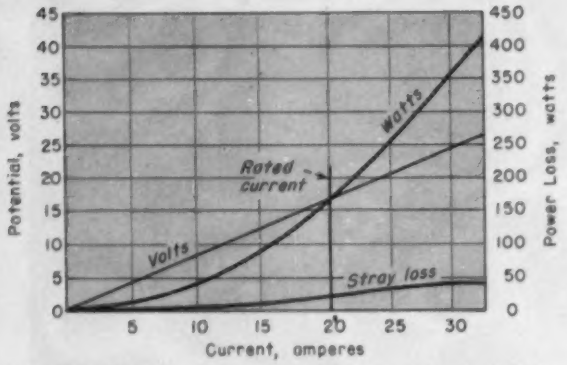
Dollar sign proved the basis for discussion when Reynolds made its announcement. Copper prices have followed a sharp up-and-down trend over the past 20 years, in contrast to the relative stability of aluminum prices. According to Dr George Perkins, general director of products and market development for Reynolds, copper price has followed a pattern quite characteristic of nonferrous metals, based on supply and demand. When demand is high, their prices are high; when demand drops off price goes down. According to Perkins the only stable period in the price of copper was during the war years when price ceilings were in effect. With an almost 50% increase in copper since January 1st, announcement of the feasibility of using anodic coating on aluminum for turn insulation is well timed. In contrast, aluminum has presented a reasonably stable price pattern for many years.

With the economic picture gradually but firmly smiling on aluminum, the engineering aspects are being scrutinized in light of the trend toward saving space in modern industrial electrical equipment. First step in this direction, Reynolds engineers felt, was eliminating some of the room now taken by insulation. Since there are but two significant parts of any electrical coil, conductor and insulation, the latter area presents the most fertile field for development. And the anodic aluminum film now appears as a likely method for reducing insulation bulk.

Anodic film on aluminum is a hard, inelastic, highly insulating product of aluminum oxide. You rarely see a piece of aluminum without an oxide film. Aluminum oxide is a microscopically thin crust which, in effect, supports the entire aluminum industry. This becomes apparent when you consider that without the protection afforded by natural oxide on an aluminum surface, there would be few aluminum applications as we know them today. Aluminum oxide provides the corrosion resistance well known in modern industry. The anodizing process simply improves on the natural oxide surface of aluminum. Instead of having an oxide film a millionth of an inch thick,



TRANSFORMER COIL, *center, is wound with anodized aluminum strip conductor. Small coils are pilot models for contactor use*



POWER LOSS *for aluminum and copper is about same. Above curves are typical for either metal: test unit rated 10 kva*

Anodic coating on thin aluminum strips may prove real dollar

anodizing builds the film up to about 0.0003 in.

Although the anodic film on aluminum is hard, abrasion resistant, boasting a high breakdown potential, it has certain drawbacks. Big problem is crazing of the anodized surface of round conductors when bent. What happens is the hard, inelastic surface film on the relatively soft ductile metal fractures; crazing on bend's outer surface, and an actual extrusion of metal through cracks on inner radius, results. It was this drawback that prompted use of a thin strip with the same cross-sectional area as the round conductor. Geometry of such a strip discourages crazing and metal extrusion through the film. There are other advantages in using a flat strip. Biggest is eliminating voids, which may occupy up to 25% of the space where round conductors are used. So adopting anodic coatings for insulation not only eliminates the thick conventional insulation but also picks up the space normally lost in voids.

Through spiral winding of a single-width conductor, the high voltage difference encountered in many conventional windings is avoided: only the turn-to-turn voltage must be provided for. In the pilot transformer wound with aluminum-strip windings, photo above, the spiral winding technique was used. According to Reynolds engineers, temperature rise encountered is not a limiting factor. Perkins states a rating is not yet available for this anodic type insulation. The only measure now on hand is the fact that aluminum oxide melts at a temperature higher than the melting point of aluminum.

Temperature advantage of aluminum anodic insulation was pointed out when, through oversight, a test transformer was left connected to a high load overnight. The transformer developed enough heat to set off the sprinkler in the test room. Later check showed the transformer undamaged.

Heat transfer with thin sheet windings appears as a definite plus factor. In many present transformers, heat generated in any interior winding must either be conducted through several layers of insulation, to get to the coil's outside, or lengthwise for some distance to reach an outside metal surface from which heat may be carried off readily. By contrast, in a transformer spirally wound with thin sheet metal, every conductor turn is exposed to an area outside the coil. Hence getting heat out is an easier job. This means cutting down possible hot spots within the coils.

Transformer size for aluminum is about the same as one wound with copper. Weight-wise the nod goes to aluminum: An electrically equivalent transformer with aluminum windings will boast a coil weight about half that of copper.

Pegging a price for an aluminum-wound transformer is a tough job today, according to Reynolds engineers. First off, the development is still in its infancy so any pricing would be pure guesstimating. Looked at from the cost of conductors alone, present prices would favor aluminum by about 2 to 1.

Equipment manufacturers, notably the leading transformer makers, are right now digging into the practicality of possible adoption of aluminum-strip-wound transformers. Reynolds has submitted sample materials to interested transformer makers who, in the final analysis, are in the best position to weigh its possibilities and limitations accurately.

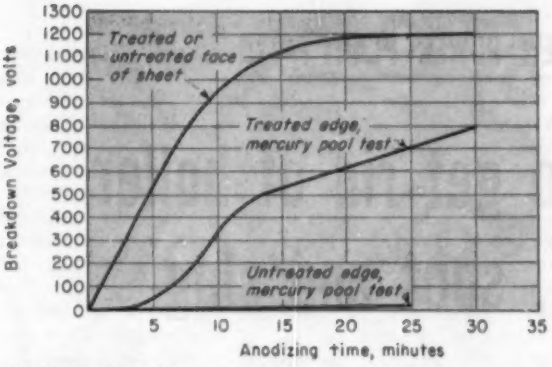
Applications are not limited to transformers, according to Reynolds engineers. Solenoid coils, as well as the field coils of dc motors, could also be wound with aluminum strip.

Perkins did not limit application in the transformer field to any one type. The feeling was that strip-aluminum windings could be applied to oil-filled as well as dry-type transformers.

Anodic film coating is brittle; hence a maximum bending radius must be maintained. Reynolds is recommending that this be no less than 0.5 in. At present an anodic film thickness of 0.002 to 0.003 in. is being used. Actually the film thickness can be varied from zero to 0.004 in. Even thicker coatings can be had, but the general feeling among Reynolds engineers is that such thickness cannot be justified for the applications outlined above. At present, sheets 0.004 to 0.040 in. thick are available, in widths from 1 to 36 in.

Overlooking the possible use of anodized strip aluminum for the moment, it is interesting to note how aluminum has been working its way into plants as an electrical conductor—at varying degrees of speed. It is growing in importance as the relative cost of aluminum continues to drop. But the summarized thinking of many equipment manufacturers is: Aluminum in time will find its proper spot but copper is and will remain the No. 1 conductor.

There's nothing really new about all this. Back in 1898, the lightweight



ANODIZING EDGES of aluminum strip, to build up an adequate dielectric strength, requires laying of uniform anodic coating

Facts about anodic coatings

Q—What's maximum bending radius for aluminum strip to prevent rupture of anodic film?
A—Right now it looks like ½ in.

Q—Can similar strips be used in motors?
A—Possibly, in dc motor fields.

Q—How thick is the anodic film?
A—About 0.0002 to 0.0003 in.

Q—What are temperature limitations?
A—Not yet definitely established. But melting point of aluminum oxide is about 2000 C. Practical limit is probably 300 to 400 C.

saver if transformer makers don't come up with major drawbacks

metal was installed as a bus conductor in the 600-v 60,000-amp bus at Niagara Works. Aluminum tubular conductors for outdoor switching stations followed. Here it offered resistance to weathering and longer permissible span lengths. It also found application in the chemical industry where copper corrosion was a problem. Aluminum has seen service in plating rooms where sulfuric acid, cyanide and cadmium oxide are present.

Where it fits. Aluminum has natural advantages that fit it for several spots in the industrial system. For overhead installations, light weight per ampere is a major factor. The fact that a larger diameter is needed than for copper proves of little importance overhead since no conduit is used. Another natural is bus work in primary substations.

Aluminum building wire got a shot in the arm by the aluminum producers for several years after the war. Then enthusiasm seemed to die down. Right now there are but mild stirrings in the attempt to promote the lightweight metal for insulated building conductors. Several years have taught the industry a few basic things about aluminum building wire. First off, there's less advantage in going to aluminum for small conductors. By small we mean about No. 6 or less. In this range, weight has little advantage and the greater number of connections may quickly cancel out any other gains.

Connecting aluminum building wire has presented its own set of problems. But any field problems that crop up today generally are there because electricians and even some design engineers fail to get more than a nodding acquaintance with the how-to side of aluminum as a wiring-system conductor.

But connections are no problem with aluminum thin strips. Here the only connections made are at the coil ends and then it's simply a matter of soldering or welding. When aluminum building wire bowed in shortly after the last war, its hard-drawn finish gave it an undesirable "springy" quality. But in short order an intermediate temper was adopted that gave better handling qualities. This change in tempering also improved "nickability"—breaking-off if accidentally nicked by the knife when insulation is skinned.

Aluminum is different. There still are basic differences between aluminum and copper. Size is one. Copper is a better conductor; aluminum is about 61% as conductive for any given wire diameter. This factor alone generally dictates larger conduits for aluminum. And that's where an aluminum installation can go off base.

You can't decide after conduit runs are laid out in an industrial power installation, that aluminum would be a good bet in some part of the system. Aluminum must be designed as a system: it needs its own connectors, larger boxes and conduit.

Aluminum oxide, mentioned above as the insulating material between coil turns in a transformer, forms whenever aluminum is exposed to air. A poor conductor, it can be scraped off but reforms immediately. Today's procedure calls for coating cable with one of several available compounds; next, the oxide is removed, generally with a wire brush. The cable end, compound and all, is then put into a connector.

Electrolytic action is another factor to consider when joining aluminum and copper where moisture is present. A miniature electric cell can be set up and one of the metals, aluminum, will be eaten away. Solution appears to be the use of tin-plated aluminum lugs. Place aluminum above copper so copper salts formed tend to flow away from the joint.

Aluminum has a higher creep rate than copper. That's why connectors for aluminum have more surface—to reduce pressure on conductors in joint yet keep them from working loose. Thermal expansion differences between copper and aluminum must also be taken into account. Aluminum's coefficient of expansion is about 38% greater than copper's. Thus usual run of copper connectors is not suitable. For a good joint connector must be designed to handle the differences in the rate of expansion of the two metals.

Making joints. In addition to the facts outlined above remember that joints can also be made with standard heat methods. Aluminum solder used with a suitable flux and torch will turn out a satisfactory aluminum-to-aluminum joint. On a large job calling for many joints consider use of argon-arc welding and aluminum terminals. No flux is needed. Resultant weld is clean, completely conductive, free of inclusions.

Bolted or compression fittings often give a faster and more reliable joint. Bolted fittings cut down installation time and require few tools. If of copper or copper alloy, they're coated for protection against electrolysis.

HOW TO ORGANIZE YOUR NEW POWER PLANT — 19

Safe modern ways to get rid of boiler wastes: ash, dust, soot and slag

- **Removing wastes with boiler rating kept up to normal**
- **Getting the best service from your dust collectors**
- **Attacking those troublesome slag and soot deposits**

By D C SWIFT, *Ebasco Services Incorporated*

► WHEN SOLID FUEL burns in a steam generator, it leaves ashes on the grate, sends dust through the unit toward the chimney, and may deposit soot and slag along the way. Here's practical info on coping with these problems, and the safety devices commonly necessary for boiler operation.

ASH REMOVAL

If you burn solid fuel, you must generally remove the ash residue. Here's how to do it in seven different firing-equipment installations.

1. In small stoker- and hand-fired furnaces with fixed grates, burn the fire down before raking ash off the grates. Clean one side of the fire at a time to keep up boiler output. Ash can build up to a 3- or 4-in. thickness before air flow is unduly hindered.

Throw live coals from one side of the grate over to the other while cleaning. Then rake them back.

It takes considerable skill to maintain boiler steam pressure under load and to avoid excessive amounts of unburned combustible in the ash when cleaning fires.

2. Underfeed stokers with dump grates are usually arranged so the amount of air supplied to rear end of live grates and to dump grates can be varied. When considerable ash accumulates, air to these sections is increased to burn out carbon remaining in the ash before dumping the grates.

If fire moves toward the dump grates unevenly, unburned coke masses extending into the ash dump grates may be broken up to aid in rapid burning and to avoid unnecessary air leakage.

Keep a continuous watch on stokers equipped with clinker grinders to see that ash moving into the grinder pit is well burned out. Clinker grinder operation is varied to hold ash (1) well up in the pit, sealing it against leakage, but (2) not so high as to interfere with fuel and ash movement down the grates.

3. Small spreader stokers with dumping grates should be cleaned of ash when it begins interfering with air flow. Sometimes coal feed and air supply are arranged in sections; then a portion of the grate may be made more or less inactive before the grate is dumped. Move fire from active sections to the clean section before dumping additional grates.

4. Operate larger spreader stokers with traveling grates to avoid carrying over unburned fuel. This involves varying grate speed and air supply to burn out the fuel before it reaches end of the grate.

5. Chain-grate and traveling-grate stokers require a similar technique. Here you vary fuel-bed thickness and air pressures in the several zones, and control the grate speed. This lets you burn fuel completely without either a lot of inactive grate surface or interference with steam pressure.

6. Dry-bottom pulverized-fuel furnaces should run with the ash hopper cool enough so ash does not fuse. Pits are usually rather deep. Otherwise, they may be covered with screen tubes to shield against furnace radiation.

Adjust fires so flames do not carry downward into ashpits too heavily. Pits may be arranged to operate flooded with water, thus avoiding high temperatures. Frequent ash removal helps prevent trouble from ash caking together or avalanching.

Ash handlers should keep clear of ash doors to avoid being burned and operators should be notified when ash will be removed. If possible, put boiler on fixed load with higher-than-normal furnace draft to assure against burning someone.

7. Wet-bottom pulverized-fuel furnaces require an opposite technique. Hold furnace temperatures high by keeping excess air low and adjusting burners to sweep lower portions of furnace walls and furnace floor. This liquefies ash and slag. Avoid an air deficiency at the burners. It may cause wall tubes to waste and reduce iron slag to a free iron condition.

You may not be able to maintain molten slag at lower ratings. In this case, let ash and slag accumulate between intermittent periods of higher load operation. Then melt it down and tap off when possible.

Observe safety precautions to mini-

mize hazards to the man tapping the slag. Maintain a steady rating, and be sure man is protected with goggles, safety gloves and shoes to avoid injury from spattered slag or splashing quenching water.

Removing ash from pits. When ash has been collected in pits, it must be removed to waste in some manner.

1. The old wheelbarrow method is the simplest. Ashes are raked or dumped out on the floor and shoveled into a wheelbarrow.

2. Larger units employ hoppers with hydraulically operated gates; ash is dumped through the gates into cars or trucks.

Take care to avoid sudden rushes. Ash may be red hot if not quenched, or, if it comes from wet pits, it may be hot and steamy. Material from dry-bottom furnaces may be handled in a similar manner.

Air or water sluicing can be used to remove ash. The latter system is more applicable to heavy pieces of slag.

3. In air sluicing a steam or water jet induces a high vacuum and heavy air flow. Material from cinder traps, and hoppers of dust collectors or boiler passes is most frequently handled with an air jet. For best operations, keep nozzles clean, see that motive steam or water is at full pressure, and admit enough air to the system to induce adequate flow for carrying the waste material. A high vacuum with little air flow will not carry ash, and pipes soon plug up.

3a. Dry-air transport systems use cyclone separators. Periodically releasing the vacuum separates ash from air. When vacuum is released, the ash drops into a storage silo. The dry ash is usually mixed with a quantity of water to keep it from creating a nuisance as it falls from the silo into trucks or railroad cars. Careful adjustment and operation gives a satisfactory moistening of ash without having it too wet.

3b. Wet-air transport systems use water for creating the air flow. Transported ash is wetted as it reaches the jet and then sluiced either to a pit for further pumping or directly to waste.

Keep the air-transport sections of either type system dry to avoid caking and plugging the lines. If furnace draft pulls air or vapor back through lines during periods when ash-removal system is idle, sluicing water or steam vapor may back up and lines may become plugged. Plugged sluice lines may also cause water to back up the air-transport lines.

4. With water-sluicing systems, slag and clinkers must be broken down manually or with grinders to 2- or 3-inch diameters. Where slag is tapped and then quenched in water, it usually shatters into fairly fine particles.

Ash pumps of wear-resistant alloy construction may remove ash and water from collecting pits; or water-operated booster jets may boost the ash-water mixture along the sluice lines to the disposal area. Transport water may be wasted or pumped back for re-use.

You need a high water velocity to carry along the slag, especially if it is heavy, dense and in fairly large chunks. Line enlargements may cause trouble when water slows and slag drops out.

DUST COLLECTORS

Mechanical. The main factor in operating mechanical dust collectors is to keep the separating tubes free and clear so each unit carries its share of the gas flow. Some installations incorporate dampers so you can cut out a section of the separator to keep gas velocities at the most effective level.

Empty the collector hoppers often enough to avoid plugging outlet end of the separating elements. Watch out for excessive moisture and low temperature in flue gas. The combination may cause dust to coat and plug both elements and hopper surfaces.

To help hold gas temperatures in the collector above the dewpoint, avoid steam and water leaks into air or flue-gas passages, insulate ducts and dust-collector casings and hoppers and bypass, or don't operate air preheaters at low loads. You may need openings to permit hand lancing or unplugging collector tubes. Flue-gas dewpoint is lower if you avoid using high-sulfur-content fuel.

Keep a close watch on pressure drop through the dust collector. If elements become plugged the trouble shows here first. Amount and color of stack discharge gives an indication of dust-collection efficiency. Of course the amount of ash in fuel, color of the sky and rating at which boiler is operating all affect stack appearance. Inspecting induced-draft fans occasionally shows whether ash removal is sufficient to prevent severe wear of fan blades and rotor. Measuring or weighing ash collected may also give a check on the collector's effectiveness.

Make at least one test of actual collector efficiency to prove that collector is capable of meeting guarantees. This also gives you a reference point for judging the stack's appearance later.

In removing flyash collections, avoid admitting air at the hopper bottoms or elsewhere because this may stir up much ash and carry it out the stack.

When you increase boiler ratings after a period of steady load operation, large amounts of ash may be picked up from low-velocity areas in the steam generator. These may overload the dust collector, and possibly overfill the collecting hoppers. This is another reason for keeping load increases gradual, and for having operators check level in dust-collector hoppers.

Level alarms are useful, but difficult to keep in good condition. Soot-blower operation also tends to overload the collector; so it's good practice to operate soot blowers frequently to spread the dust load.

Electrostatic dust collectors require much the same precautions as mechanical units. But they usually do not plug. Hence pressure drop across the collector does not indicate cleanliness. Voltage must be kept as near normal as possible without sparking, and elements be in place for correct spacing.

Where automatic rappers are not incorporated, use frequent manual rapping to prevent carrying out dust puffs when large dust accumulations drop off the elements.

Help plant to run smoothly with frequent soot-blower operation and gradual load pickups, plus cleaning out of collector hoppers.

SLAG AND SOOT REMOVAL

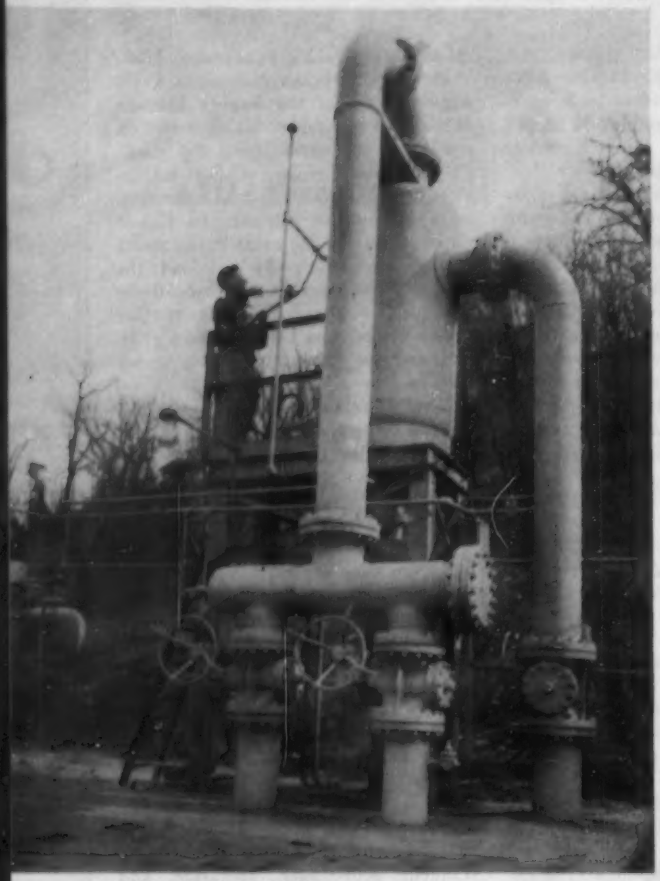
In solid-fuel-burning boilers, and to some extent in oil-burning units, soot and slag deposits accumulate on furnace, waterwall, superheater, boiler, economizer and air-heater surfaces. You must remove these deposits periodically to maintain heat transfer at design level and keep gas-flow passages clear.

Deposits on burners. Slag sometimes builds up above or below pulverized-fuel burners and interferes with proper operation. Inspect burners every hour or two to see that they are working properly. Use bars to clean off any interfering slag deposits, taking care not to damage burner brickwork or waterwall tubes. You may have to lower boiler rating or take certain burners out of service to cool deposits so they may be chipped off. Water lances sometimes help cool and disintegrate clinkers.

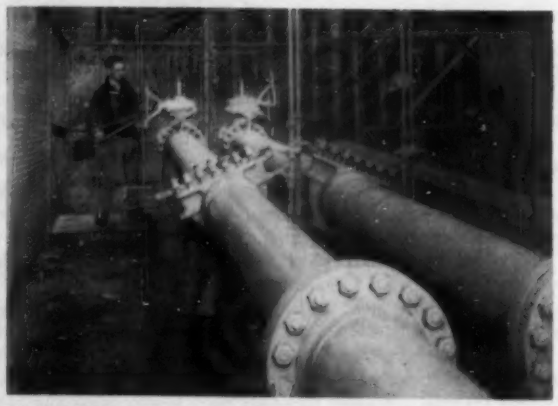
Type of furnace wall, ash-fusing temperature, furnace heat-release rate,

(*Continued on page* 196)

OUTDOOR-METERING STATION: piping and valves



PIPING ARRANGEMENT at metering station shows 12-in. gas main, *right;* odorizer and scrubber, *center;* meter runs below



DUAL METER RUN at metering station for the gas-distribution system. Power-plant operator is using gun to lubricate valve

MOTORIZED main shutoff valve on 12-in. header from gas plant can be remotely run from power plant or meter station

Lubricated plug valves—tops for gas fuels

By JOHN B PECK, *Plant Superintendent, Glenwood Station, Long Island Lighting Co*

► GLENWOOD STATION of Long Island Lighting Co has eight combination-fired steam generators, six of which may use natural gas as fuel. Transcontinental Pipeline Co supplies the gas.

Valving a natural-gas piping system presents somewhat different problems from those met in other central-station systems, like steam, water, fuel oil. Tight, positive valve closure is both desirable and difficult—desirable from a safety and economy angle to prevent leakage of the light gas past the valve seat, difficult because of the lightness of the fluid handled.

Five years' operating experience with lubricated plug valves on our gas system indicates this class of valve is eminently satisfactory. They give excellent closure, require little routine maintenance, and plant operators report that they are both quick and easy to operate.

Gas system. A 12-in. line delivers gas from the 16-in. transmission main to the power-plant metering station. Two regulators in a pit maintain desired pressure. Gas passes through a scrubber and odorizer before going to the regulator. Pressure is reduced from 200 to 45 psi, and then to 1-7 psi at the burners.

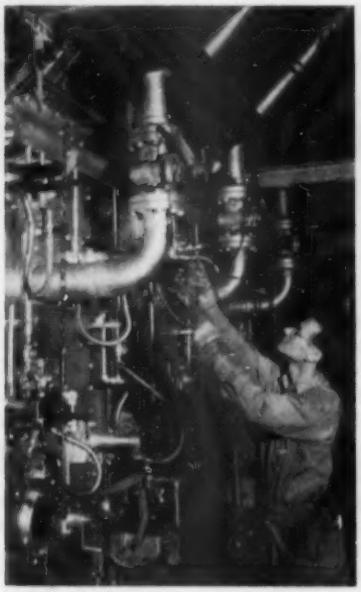
Metering run consists of two parallel 10-in. lines tying into the 12-in. main going to the boiler-plant area. This line supplies the 8-in. headers serving each of the six boilers that use fuel gas. Lines from the headers are 4 in.

Two valve arrangements are used at the boilers—one for the four Babcock & Wilcox units, and one for the two Combustion Engineering units. The B&W boilers are front-fired, so the burner gas lines are controlled by four valves, one at each cock at the windbox. Since the CE boilers are tangentially fired, the valves are at each of the four boiler corners.

Valves. The Rockwell-Nordstrom lubricated plug valves are strategically

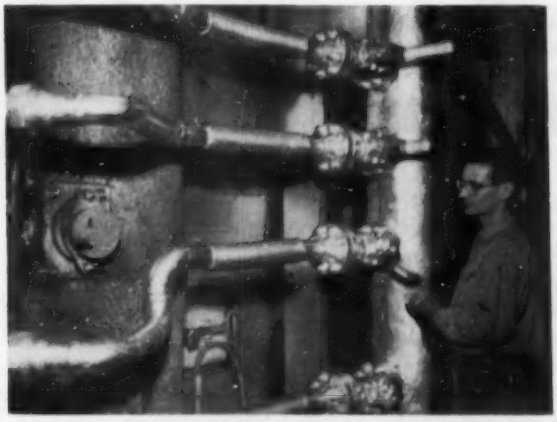
INSIDE THE PLANT: valves for various jobs

COMPACT VALVE, used as main shutoff, insulated to reduce noise of gas in pipe

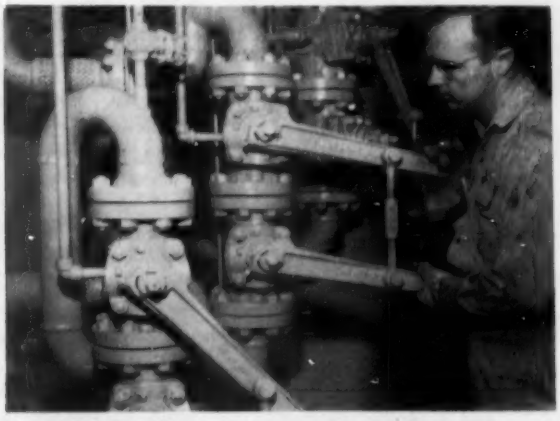


FUEL-GAS COCKS on boiler front are high above floor, have lever-chain operators

VALVE LUBRICATION simple and quick with gun, job of operator in the valve area



BOILER CORNER has lubricated plug valves on the gas line to the boiler gas cocks. These four valves are manually operated



HAND-LEVER LINK permits operator to open valves on gas cock, while at same time closing vent valve attached to vent line

distributed throughout the gas system, acting essentially as block valves, though in the 1-in. size they are also used as vent cocks.

There are a variety of valve operators, ranging from simple manual operation with levers to remote controls. Type of control depends on the application. Main shutoff valve on the 12-in. header from the gas plant is motorized. It can be remotely operated by pushbutton from the main switchboard in the power plant or at the metering station. In emergency, a handwheel and worm gear can operate the valve manually.

A 10-in. plug valve at the inlet and outlet of each of the two meter runs is manually operated. Main shutoff valve on the boiler headers, to five of the six gas-fired boilers, is pneumatically operated from the control board because it is not readily accessible for hand operation. When the valve is opened, the vent cock, actuated by the same piston as the block valve, is closed. When the block valve closes, the vent cock opens.

For the B&W boilers, the gas-cock valves are hand-operated by chains because they are overhead. Gas-cock valves for the CE boiler, which are at operator level, have conventional hand wrenches for opening and closing.

The CE boiler, put into operation in 1952 and designed for all types of fuel, uses a somewhat different arrangement. Here, the shutoff valve, which is readily accessible, is operated by a wheel and worm gear. Rather than vent the gas main downstream from the block valve, this is done more efficiently at the gas cocks. At the boiler corners, each gas-cock valve is paired with a combination straight-through and vent cock, with the hand lever for each linked with a short tie rod. When operator closes the main valve the combination valve opens for venting.

Lubrication, maintenance. Lubri-

(*Continued on page 206*)

Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Army Package Power Reactor being built by Alco Products, Inc will feed a 2500-kw geared turbine-generator built by General Electric Co. Unit will "roll" in 1957 at the U.S. Army Engineers Research and Development Laboratories, Fort Belvoir, Va. Plant is expected to run at full load for 18 months on a small fuel charge. Reactor and steam generator housed in 36x64-ft vaportight steel cylinder can feed any turbine in emergency.

AEC is inviting proposals for development, design, construction and operation of nuclear-power plants in size ranges of 5-10, 10-20 and 20-40 mw. Proposals will be accepted up to February 1, 1956. Anyone meeting the qualifications of responsibility can enter this second phase of the AEC's Power Demonstration Reactor Program. The AEC may accept one or more propositions within the limits of the funds and materials it has available.

"Atoms for Peace Awards" was established by Ford Motor Co with an appropriation of $1 million. The fund will provide $100,000 a year for 10 years to grant awards to any scientist, inventor or engineer who has found new ways to make atomic energy useful to civilization. An independent committee headed by Dr J R Killian, Jr of MIT will administer the fund. When group or individual cannot be found as meriting $75,000 honorarium in any one year, the money will be used for scholarships and fellowships in atomic-energy activities.

Geneva Conference Proceedings will be published by UN and will include all 1000-plus papers and the discussion of the papers presented orally. Proceedings will be in 16 volumes, about 500 pp each. Prepublication price up to Dec 31, 1955 is $110 for the set. Individual volume prices will be announced later. Order from UN headquarters Bookshop, Columbia University Press, or other agents.

Controlled thermonuclear energy research is being carried on at Princeton University, and at AEC labs run by University of California at Los Alamos, N. M., and Livermore, Calif. There also are projects at Oak Ridge and New York University. These groups all participate in Project Sherwood, which has been under way for several years. Many years of intensive effort may be needed before the first operating thermonuclear machine is achieved.

Sun's enormous energy is believed to be released by thermonuclear reactions. We must find out how to heat nuclear material, such as deuterium, to *several 100 million F* and confine it long enough to make the light nuclei fuse together. The fusion releases energy as high-speed neutrons and charged particles.

Formidable problems in controlling thermonuclear reactions concern: (1) containing gases heated to more than 100 million F (2) getting back the energy needed to raise the gases to reacting temperatures so power cycle has economical efficiency. Existing theories of matter structure do not apply to these conditions—so new investigations to formulate theories are needed.

More action on fusion research may be in the offing. Senator Clinton Anderson, chairman of Joint Congressional Committee, indicated AEC is now spending less than $30 million yearly in this field. He made strong bid to enlist American Industry in the research effort, same as on power-reactor program.

Power's DATA SHEET

No. 281

3 PHASE 85% P F 80% EFFICIENCY				11 KV	2.3 KV	480V	240V	220V	208V
$I = \frac{KW \times 1000}{1.73 \times E \times PF}$	OR	KW	TIMES	.062	.296	1.417	2.834	3.091	3.269
$I = \frac{KVA \times 1000}{1.73 \times E}$		KVA		.053	.251	1.204	2.408	2.627	2.779
$KW = \frac{I \times E \times 1.73 \times PF}{1000}$		I		16.176	3.382	.706	.353	.324	306
$KVA = \frac{I \times E \times 1.73}{1000}$		I		19.030	3.979	.830	.415	.381	.360
$HP = \frac{I \times E \times 1.73 \times EFF \times PF}{746}$		I		17.346	3.640	.757	.378	.347	.328
$I = \frac{HP \times 746}{1.73 \times E \times EFF \times PF}$		HP		.058	.275	1.322	2.642	2.882	3.049
2 PHASE 4 WIRE 85% P F 80% EFF				11 KV	2.3 KV	550V	440V	240V	220V
$I = \frac{KW \times 1000}{2 \times E \times PF}$	OR	KW	TIMES	.053	.256	1.070	1.340	2.451	2.674
$I = \frac{KVA \times 1000}{2 \times E}$		KVA		.045	.217	.909	1.136	2.334	2.273
$KW = \frac{I \times E \times PF \times 2}{1000}$		I		18.700	3.910	.935	.748	.808	.364
$KVA = \frac{I \times E \times 2}{1000}$		I		22.000	4.600	1.100	.880	.480	.440
$HP = \frac{I \times E \times 2 \times EFF \times PF}{746}$		I		17.775	4.193	1.003	.802	.438	.402
$I = \frac{HP \times 746}{2 \times E \times EFF \times PF}$		HP		.056	.238	.997	1.247	2.286	2.491
1 PHASE 85% P F 80% EFFICIENCY				480V	240V	220V	208V	120V	110V
$I = \frac{KW \times 1000}{E \times PF}$	OR	KW	TIMES	2.451	4.901	5.348	5.650	9.804	10.695
$I = \frac{KVA \times 1000}{E}$		KVA		2.083	4.167	4.545	4.808	8.333	9.091
$KW = \frac{I \times E \times PF}{1000}$		I		.408	.204	.187	.177	.102	.094
$KVA = \frac{I \times E}{1000}$		I		.480	.240	.220	.208	.120	.110
$HP = \frac{I \times E \times EFF \times PF}{746}$		I		.438	.219	.201	.190	.109	.100
$I = \frac{HP \times 746}{E \times EFF \times PF}$		HP		2.279	4.571	4.961	5.271	9.142	9.973
D C 80% EFFICIENCY				220V	110V	48V	24V	12V	6V
$I = \frac{KW \times 1000}{E}$	OR	KW	TIMES	4.545	9.091	20.833	41.666	83.333	166.67
$KW = \frac{I \times E}{1000}$		I		.220	.110	.048	.024	.012	.006
$HP = \frac{I \times E \times EFF}{746}$		I		.236	.118	.051	.012	.013	.0064
$I = \frac{HP \times 746}{E \times EFF}$		HP		4.239	8.477	19.427	33.304	77.708	155.42

Constants make electrical calculations easier

► ANYONE can use this table to solve plant electrical problems without a slide rule or laborious pencil work. With it you will get accurate solutions in seconds.

Example: How many amperes per phase is it possible to draw from a transformer rated at 100-kva 3-phase 120/208-volt?

Solution: Table gives constants for finding unknown electrical units in terms of known ones. Using the formula I = (kva × 1000) ÷ (1.73 × E), for a 3-phase installation, 85% power factor, we find that the work can be simplified to merely multiplying the known kva by a constant in the table. Constant is 2.779 for 208 volts. Multiplying, we get 2.779 × 100, or 277.9 amp per phase.

WM O'BRIEN *E. Hartford, Conn.*

Flintkote Company *Modernized* a Power Plant

when Flintkote Company modernized its power plant at its Ridgefield Park, N. J. building-paper mill it went all out

and now gets

20% more steam
21% more efficiency
33% savings in fuel cost
33% less maintenance costs

. . . proving that it pays to modernize

CONGRATULATIONS

to The Flintkote Company for its citation received in POWER'S 1955 Modernization Program

Five out of twelve citation winners for their modernization of steam-power facilities feature Riley Steam Generating Units and Riley Fuel Burning Equipment

the others are:

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Carbide & Carbon Co., Blaine Island, So. Charleston, W. Va.

The Garlock Packing Co., Palmyra, N. Y.

The Pennsylvania Railroad, Juniata Shops, Altoona, Pa.

FLINTKOTE'S PROBLEMS:

- Increase steam capacity to provide 20% margin for future requirements.
- Increase steam generating efficiency.
- Utilize two lower cost fuels, bituminous coal and #6 oil, in place of anthracite.
- Provide for possible future shortage of one of these fuels.
- Reduce average $20,000 annual maintenance cost.
- Complete modernization without interrupting production
- Utilize existing plant building.

RX:

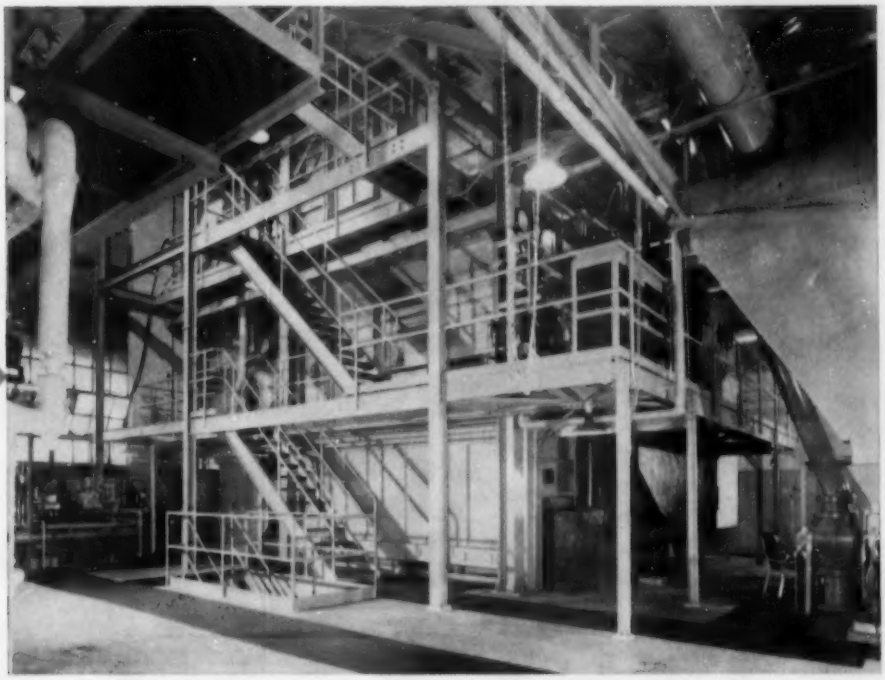
- Replace two older stoker fired units burning anthracite with a Riley Unit fired by Riley Flare Type Burners and Riley Pulverizers.
- Overhaul and convert one of the three old units to oil firing as standby unit.
- Provide automatic combustion controls and up-to-date coal handling and ash removal systems.

RESULTS:

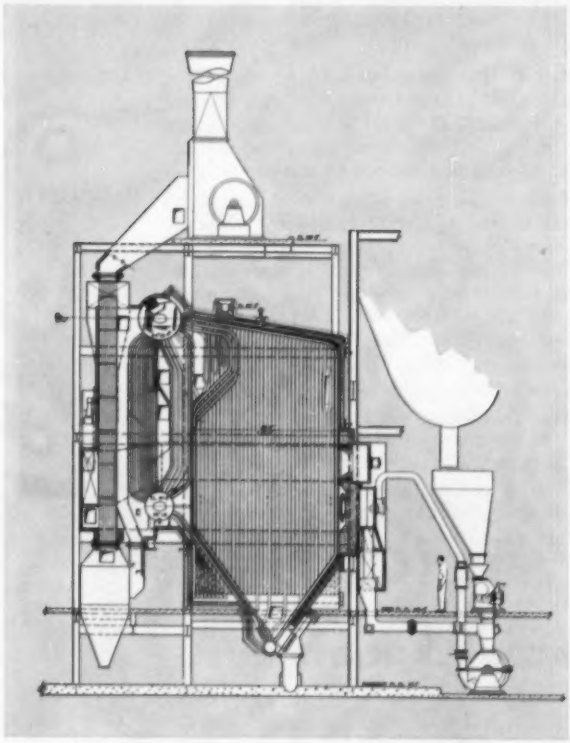
- Work was accomplished without interruption to paper mill production; tie-ins were made during normal plant shutdown.
- Operators were thoroughly trained to fire new fuels and equipment.
- Efficiency increased from 71% to over 86%.
- Fuel costs were lowered from 67.5c per 1000 lbs. of steam to 46c per 1000 lbs. of steam with a total annual savings in fuel costs of $55,000 plus a substantially reduced maintenance cost.

RILEY designs, engineers, manufactures and erects complete steam generating units for Public Utility Central Stations and Industrial Power and Heating Plants

and now saves $55,000 on fuel costs alone



with RILEY Steam Generating and Fuel Burning Equipment



Engineering Data of Equipment furnished to Flintkote Co. by RILEY

One 60,000 lbs/hr RX Steam Generating Unit complete with Riley Air Heater, Superheater and featuring patented Riley Single Header Hopper Bottom; Two Riley Flare Type Burners

*One Riley 50 Pulverizer
Guaranteed Efficiency at 60,000 lbs/hr — 85.3%
Actual Operating Efficiency exceeding 86%.

*It will pay you to investigate the savings that can be affected when you install Riley Pulverizers to fire boilers of 50,000 to 75,000 lbs/hr capacity.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

INSIDE STORY
on cooling tower pH

Deep in the interior of a giant cooling tower visibility is obscured by shadows, and haze that's actually cooling water, falling like rain down into the tower basin, where it's collected and recirculated to the condensers.

Keeping this water at optimum pH, when it collects in the basin, was once a difficult problem. But the application of practical engineering principles, resulting in the baffle-lined distributing trough and regulated reagent feed shown here, plus L&N's pH Controllability Analysis, offers a new and successful solution to this problem.

For it's here, *inside the tower*, that vital pH control can be most effective for slime control, scale prevention, wood protection, and conservation of make-up water.

We'll be glad to send you details on the "inside story" of tower pH. Write Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa., for Process Data Sheet 700(1).

LEEDS NORTHRUP
instruments *automatic controls* • *furnaces*

PLANT OPERATION and MAINTENANCE
NOVEMBER 1955 SECTION
STEVE ELONKA
Associate Editor in Charge

Mr Plant Engineer, don't close your eyes to process wastes

By PAUL D HOBSON, *Research Associate, Penn State U*

► MANY WELL-RUN PLANTS have excellent power-generating departments, but some plant engineers blind themselves when they go into the main plant—if they ever set foot there at all. Often much time and money are spent to raise efficiency of the power plant 1 or 2%, while just outside in the shop, expensive heat literally goes down the drain.

Heat balances and elaborate metering are needed to pick out many sources of heat waste. But you can do much by walking around with your eyes and ears open. Some of the chief power wastes are noted below. I know none of them is in *your* plant. But it might be fun to try spotting them next time you visit your *neighbor's* plant.

Waste is mostly a management problem. Some wasteful practices are ob-

Reprocessing costs money...

Don't ventilate like this...

Your power plant is usually much more efficient than your process

vious, though not uncommon. Chief among these are:

1. Using compressed air for ventilation. If ventilation is needed in a hot section, it's cheaper to provide a fan than to have employes use an air line.

2. Running water or air needlessly. Awkward or inaccessible valves are often the reason.

3. Unnecessary reprocessing, as with dirtied laundry or spilt sugar. Find the cause and prevent. It's much cheaper than reprocessing.

4. Process equipment set for a higher rate of feed than is actually possible. Results are partly-empty boiling vats, dryers, etc. Underloaded dryers waste a lot of steam in many plants, especially if they are hot-air dryers.

5. Overdilution of materials that must later be concentrated by evaporation. Many processes are made easier for the operators by overdiluting the solutions. Trouble is it takes about a ton of coal to evaporate 10 tons of water in a fairly efficient plant. Let's say you must concentrate 1000 tons of solution. Change from 65 to 63% initial concentration takes about three more tons of coal to evaporate the solution.

6. Keeping material in process too long. While this is often possible with no harm to the product, it's a costly practice. It often has no effect on output, and may smooth out hitches in process. But all this extra material is losing heat while hanging about in the vats. Lost heat has to be replaced—and paid for.

7. Leaving machines when they are running idle. Idle load on most machine tools is around 75% of working load, while many production-line machines may run as high as 95% of working load. Average is about 70%. Yet machines often run idle through break periods, eating up power. Employes may argue, "It isn't using current, it's not on load."

8. Improper or inadequate lubrication. Wrong kind of lubricant may up power consumption enormously. If a machine gets very hot when running, it's wasting power. Get advice of consultant or oil-company engineer and save money.

9. Incorrectly sized centrifugal pumps or fans. Sometimes a "temporary" hookup is put in to save a few dollars. Then it's left to waste power for years. An oversized centrifugal pump or fan whose discharge is throttled directly or by undersized piping can easily operate under 5% of efficiency.

10. Running machines too fast. Machines are frequently run too fast. Often much lower speed may increase net output by reducing spoilage and operator fatigue, also may reduce power consumption. It's sometimes hard to persuade piecework operators to slow down. Power waste of overspeeded centrifugal pumps or fans is very high. Often you can replace a small centrifugal with a reciprocating pump with power savings as high as 60%. At small outputs and high pressures, reciprocating pump will always win, even though its first cost may be higher.

In many machines, such as mixers, tumbling barrels and rotary kilns, there is no direct relationship between speed and output. You can often reduce speed of these units greatly, saving power and giving a product as good as or even better than you produced at higher speed. Many conveyors run faster than needed to carry peak load. Not all machines will allow a speed change without a lot of time and work. But when it can be done reasonably, a little experiment in speed reduction gives worthwhile returns.

11. Processing at too high a temperature. Waste here is obvious.

12. Steam traps waste enormous amounts of heat in too many plants. Operator finds that by opening the trap's bypass, heat transfer in his heater, dryer or whatnot is much improved because air is removed instantly and steam flows faster. If bypasses must

Idling motors eat up power...

Top production not always good

and here are 15 places to plug those process wastes

be fitted, keep them small—less than full pipe size. At set periods, have bypasses checked for being closed. Also check the traps.

Unlagged float or bucket-type traps are often put outside in the cold. There they usually get no maintenance, adding further to wasteful practices.

13. Leaks. Loss of fluid through 1/16-in.-diameter hole is very high. Let's assume your boiler plant is fairly efficient and that a line is under pressure six days a week. If it is a 100-psi saturated-steam line, loss in wasted coal is about eight tons per year. How many leaks are there in your plant? Pinholes, leaking valve spindles, weak and underbolted flanges, defective joints, drain cocks left open unnecessarily? All waste good steam from steam lines.

In older plants, weak underbolted nonstandard flanges are one of the most common causes of leaks. Don't forget that erosive effect of high-pressure steam is costly. If a hole is not stopped, superheated steam can double its size in a few weeks, or even days. Your loss increases with square of leak's diameter.

Plain safety valves can waste a lot of steam. If such a valve is to be fully open at 215 psi, it will usually be breaking at 200 psi. Also, sometimes a boiler-room staff likes to "keep a feather at the valve." That tells them they are up to pressure. This is especially so when one boiler in a set, delivering to a common header, is set 5 psi or so lower than the rest to act as a "sentinel." Such a valve usually blows all the time. This has nothing to do with correct practice of setting a superheater safety valve lower than shell safety on same boiler.

14. Lagging. There's a lot of good information on lagging. But you should remember these points. Don't lag everything in sight. Lagging a line carrying condensate to a hotwell may make the discharge so hot that the pump cannot handle it. Or it may cause flashing as condensate leaves the line. Where you must keep heat in line, question of whether to lag becomes one of economy.

A little lagging is much better than none. To have elaborate lagging on some parts of a system and none on others is throwing money away. Don't forget flanges. Area of a pair of flanges is about the same as that of 12 to 15 inches of corresponding-size pipe. Also, thermal stresses on bare flanges are a major cause of leaks.

Don't crush lagging by leaning ladders, etc, on it, or allow it to get wet or oil-soaked. All these careless acts reduce effectiveness greatly. Keep canvas jacket in good repair and painted, preferably with aluminum paint. Steel-sheet covering costs about 50% more than canvas, but increases life up to five times.

Cheap lagging saves little in installed expense, but costs a lot in waste heat. 85% magnesia in molded sections is often good up to 600-F temperature. Good asbestos and glass-wool lagging are also economical.

Shield lagging from wind or drafts. Heat loss goes up fast when air blows directly on lagging's surface. Don't forget to lag process tanks, boilers and any container that has to be kept hot, however heated. The hotter the fluid, the thicker the lagging must be.

15. Space heating. Systems with thermostats set too high, or none at all, may be pouring Btu's out of windows opened to keep the temperature bearable. Sometimes poor or nonexistent ventilation systems force occupants to open windows to breathe.

Next time you visit the plant next door, see how many of these points you can spot. You might even have a look around your own plant—the money you can save on your power services may surprise you.

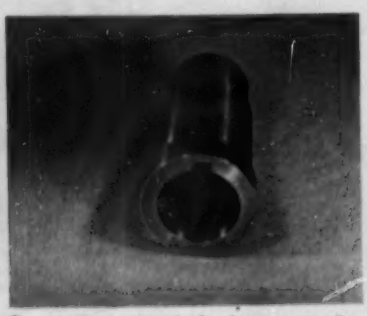
EDITOR'S NOTE: *What important areas did Hobson leave out? Send us some of the wasteful practices you have seen in plants. We'll publish them.*

OPERATORS' NOTEBOOK 91

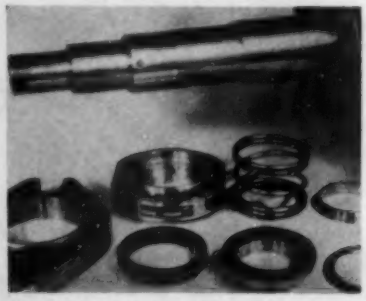
Here's one way to convert

Follow these steps

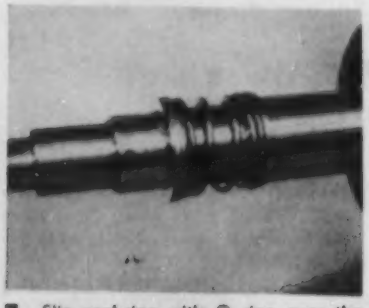
1 Dismantle pump; remove burrs, sharp corners from shaft, also from the shaft threads. Shaft must be free of defects at O-ring location, see sketch



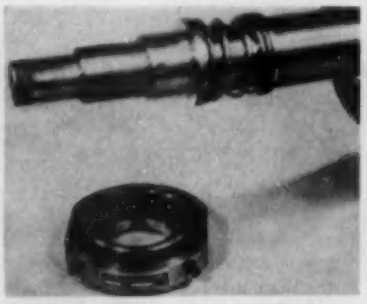
2 Machine the shaft sleeve according to drawing furnished by seal firm. If your pump's shaft has no sleeve, seal will be supplied to fit your present shaft



3 Here are mechanical seal parts, also gland backing-flange machined to fit the gland. Sleeve is machined and on the shaft, ready to receive the seal

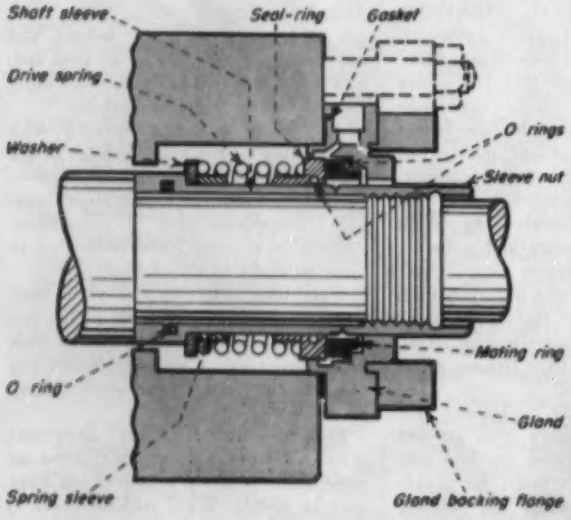


7 Slip seal-ring with O ring over the shaft; don't harm O ring. Turn ring so it spreads the drive-spring open, is held firmly in place as shown, sketch



8 Shaft sleeve here has drive-spring with seal-ring, all rotating parts. Seal-ring face is lapped to within a few millionths of an inch; don't harm face

9 Place stationary unit (gland, gland backing-flange, seal-ring, gasket) on shaft. Take care not to harm lapped sealing faces; keep these parts clean



How seal works

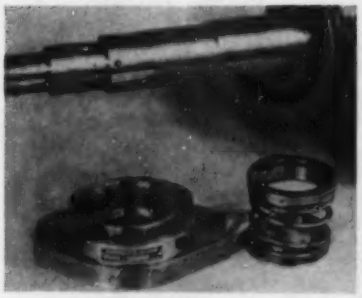
► MECHANICAL SEAL has come to mean two flat surfaces with sealing faces at right angles to the rotating shaft. This makes it an axial seal, also. Because these two rings take all the wear, they save the shaft. One ring is fastened to the shaft and rotates, while the other is stationary. Usually one ring is metal with a hardened face, while the other is a composition carbon ceramic, or metal. Instead of a metal ring, some small pump shafts have a lapped shoulder that the carbon ring seals against.

One ring is mounted so it moves axially with the shaft. That allows its face to remain in contact with the stationary ring, regardless of shaft endplay, sealing-face wear or sealing face run-out. So this ring, usually called the seal ring, must be mounted flexibly.

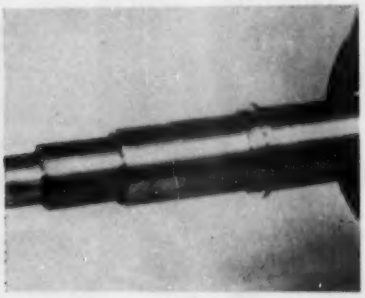
The opposing ring, known as the mating ring, is mounted rigidly to the gland or pump housing. This rigid ring is backed up with a gasket or O ring to prevent leakage.

your pump to mechanical seals

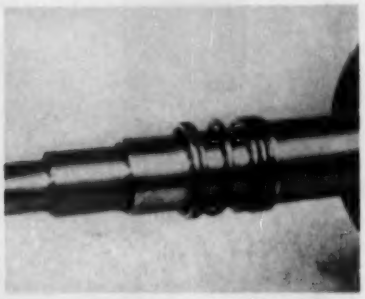
BY STEVE ELONKA, *Associate Editor*



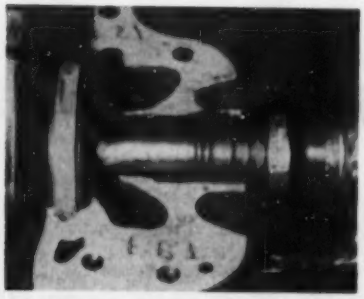
4 Mating ring (carbon) is inside gland here and gland is on gland backing-flange. Drive spring is also assembled with seal ring to show how unit looks



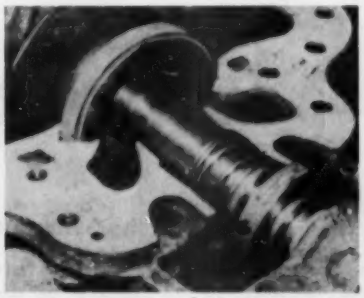
5 Slide washer against sleeve shoulder, then slip spring-sleeve against the washer. Sleeve is split so drive spring will hold it tightly against the shaft



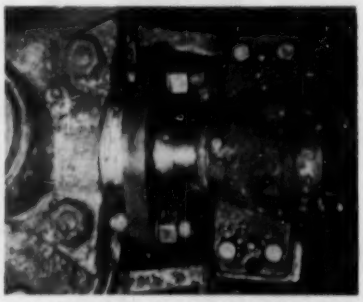
6 Place spring over split spring-sleeve with turning motion. Turn right-hand spring clockwise, left-hand spring on shaft's other end counterclockwise



10 Install pump rotor assembly in the pump casing. Center impellers in the pump casing recesses. Lock impellers, sleeves and nuts in place with screws



11 Cut pump-casing gasket so gasket extends beyond the stuffing-box face. Bolt down casing head, then cut off the gasket flush with face at stuffing box



12 With pump closed, gasket flush with casing to prevent leakage between upper and lower halves, assemble back-up flange and bolt the gland evenly

There are many types of mechanical seals—stationary, rotary, balanced, unbalanced, bellows, diaphragm. These and others on the market will be covered in detail in POWER's 24-page report on Mechanical Seals in March 1956.

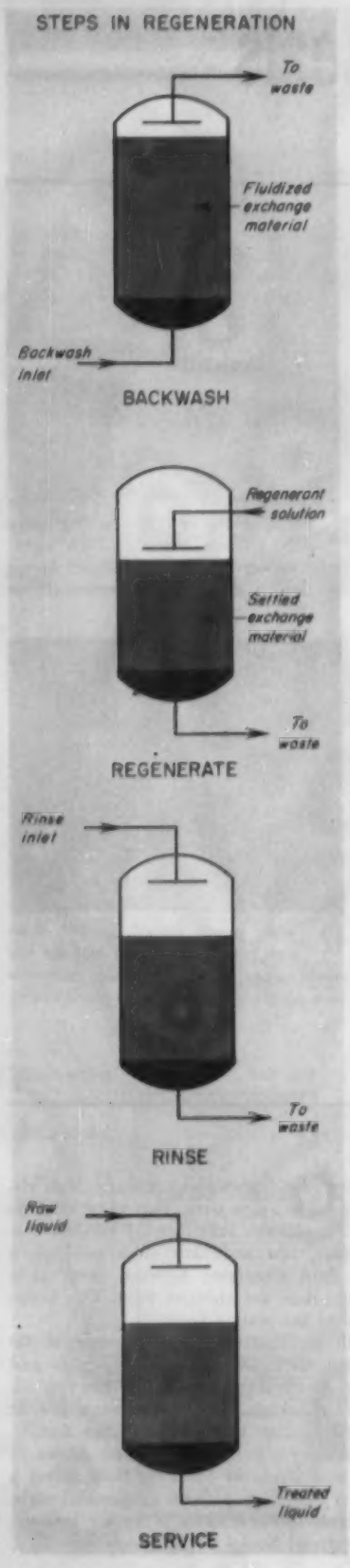
While mechanical seals are relatively new in industry, most of us use them without knowing it. The water pump in your car and the one in our hot-water heating system at home are the best examples. You don't know you have them because they don't leak and so do not have to be repacked or adjusted.

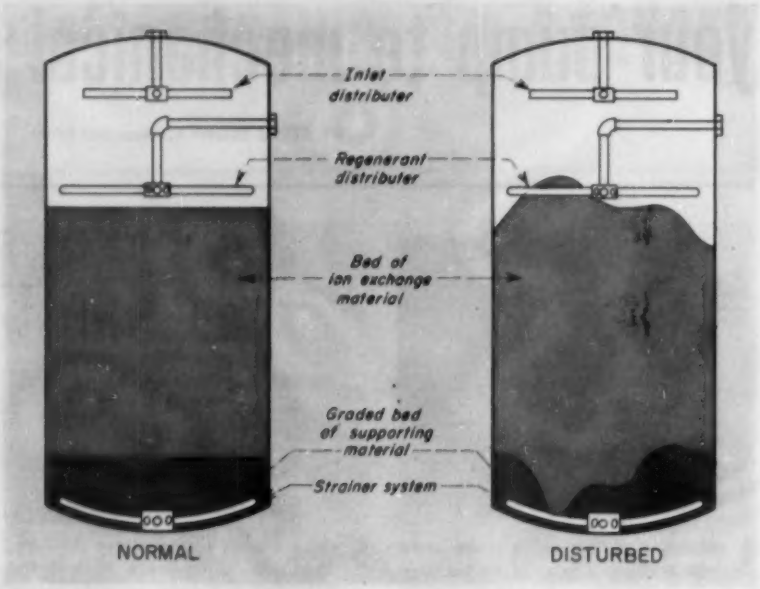
One disadvantage of a mechanical seal for a large industrial unit is that it must be installed over the shaft's end. That means breaking the coupling and removing the motor. If a seal is installed for the first time, as in these photos, then the pump impeller must be removed as shown. This is best done during the usual annual overhaul, when pump is opened up anyway. Then this job can be done correctly.

An advantage is that these seals don't usually leak visibly. What leakage there is evaporates. But when they do start leaking, it's ordinarily the first sign of trouble. For pumping abrasive fluids, two seals are often used on a shaft, with a clean fluid circulated between them at a slightly higher pressure than the abrasive fluid. This keeps the harmful solids out of the sealing faces.

Seals are now built for shafts revolving at over 40,000 rpm. Fluids sealed include crude oil, gasoline, acids and all kinds of corrosive chemicals. Pump shown handles oil, kerosene and gasoline. Leakage here can mean a fire or asphyxiation in closed spaces. For pumps lifting liquids, leakage through packing on suction side often draws in air, reduces vacuum and increases pumping time unless a sealing fluid is used in lantern ring. With mechanical seals, stripping time is reduced because there is no air leakage.

Courtesy, Sealol Corp, Providence, R. I.





PROBING the exchange material with a thin rod tells whether bed depth is normal and supporting material level or disturbed. Check condition at least once a year

Smart maintenance can

Here are the symptoms, causes and remedies for each of the three basic ion-exchanger troubles, plus info on how to unload a unit

By **GREG KLEBANOFF, JR,** *The Permutit Company*

► To UNDERSTAND ion-exchange maintenance, we must first know how the equipment works in ordinary service.

How unit works. Ion exchange is a unit operation used to trade unwanted ions in solution for desired ions. The exchange material itself is usually a bed of granular or beadlike particles. These are housed in a cylinder or shell like those used for pressure sand filters. Like a sand filter, the cylinder has an inlet distributor at the top and a collector or strainer system at the bottom. A bed of graded and chemically inert gravel supports the ion-exchange material. Gravel rests directly on the strainer system in several layers, with the coarsest layer on the bottom.

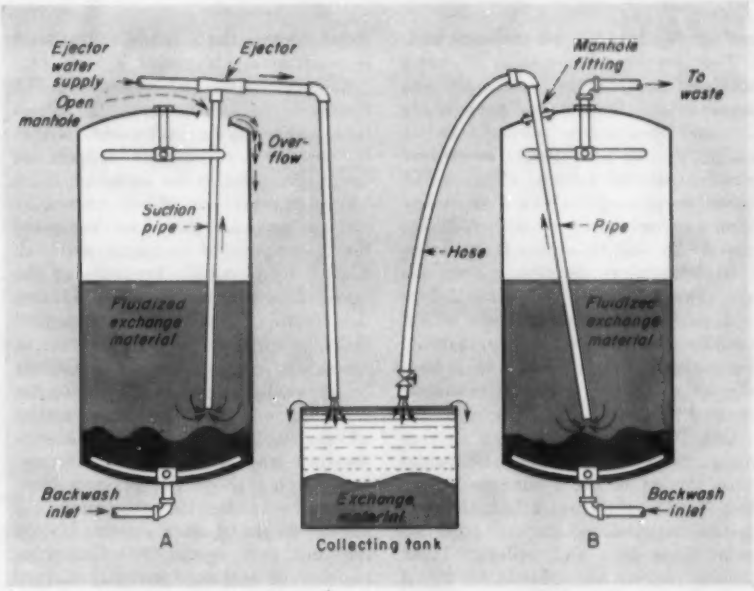
Unlike a filter, the exchanger requires additional piping and equipment for periodically regenerating the exchange material. Three basic regeneration steps are shown in panel at left:

1. Backwash — Liquid passes up through unit, fluidizing the exchange material, so foreign material collected during the service run can be washed out.

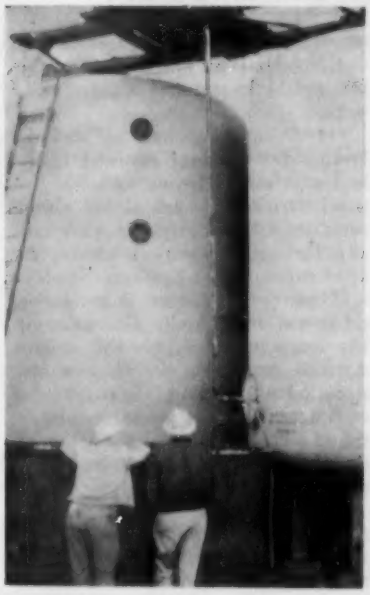
2. Regenerate—A regenerant solution passes down through the unit, reversing the reaction that occurred during service. This removes unwanted ions from the exchange material and replaces them with wanted ions.

3. Rinse—Unit is rinsed free of reaction products and excess regenerant solution.

After rinsing, the unit is returned to service. Ion-exchange material removes unwanted ions from the liquid.



HYDRAULIC UNLOADING uses either *(A)* ejector or *(B)* pipe fitted to the manhole cover to remove liquid and exchange material. Backwash slowly while unloading



EXCHANGE material collects in tank as operators unload this cation exchanger

kill your ion-exchange troubles

While this operation was first used in water treatment, applications are spreading rapidly. It is now used in the chemical industry wherever ions in solution must be swapped.

There are three models of ion-exchange units: fully automatic, push-button automatic and manually operated. While these units are simple, functional in design and noted for sturdiness, things sometimes go wrong, and a check-up is necessary. First step in trouble shooting is to determine if the unit itself and not some external influence is at fault.

You can easily spot and remedy electrical troubles in the controls, but other things may happen and the causes may seem obscure. Let's examine the symptoms, causes and remedies of the possible troubles without discussing the chemistry involved. Only three things can go wrong:

(1) Volume of liquid that unit can treat may decrease. (2) Results obtained may become unsatisfactory. (3) Flow rate through the exchanger may decrease.

Decrease in capacity. When volume that unit can treat decreases, check to see that ion content of entering liquid has not changed. An exchanger is not rated by the liquid volume that can pass through it, but by the number of ions it will exchange before becoming exhausted. If ion concentration in the entering liquid increases, volume that can be treated will decrease.

If entering liquid has not changed, see if the regenerating procedure is being carried out properly. Check the various flow rates employed, and determine that: (1) regenerating chemical is the grade recommended by the exchange-material supplier (2) you are using enough chemical; amount consumed over a period of time divided by the number of regenerations performed indicates the quantity used each time (3) chemical concentration is as specified in the instructions; you need this to get the right equilibrium for effective regeneration.

Length of time regenerant solution contacts the exchange material is also important, to let the chemical equilibrium shift in the desired direction. Otherwise, unwanted ions are not removed efficiently from the exchange material.

If the regenerating procedure proves flawless, examine the internals. Do this when you can conveniently take unit out of service. Check for visible troubles like slime, foreign material on top of the bed, uneven bed, and mechanical failure in the regenerant distributor. See if regenerant solution is evenly distributed over the bed, by introducing water through the inlet distributor. Spray pattern should be symmetrical. If not, clogged fittings are indicated.

Probe the bed with a thin metal rod that is kept as nearly vertical as possible. If you can get into the unit, and if available space prohibits using a rod, a folding ruler may suffice. Lay a flat board on top of the exchange material for a platform while probing. Avoid stepping on the regenerant distributors.

Check exchange-material depth at several points to determine that (1) the bed depth is OK and (2) supporting material is not upset (see sketch, p 112). You should have no difficulty in feeling the bottom of the exchange material, since the rod will stop when it contacts the coarser texture of the supporting material.

If bed depth does not check with the unit specifications, and does not fall within the manufacturer's guaran-

tee of normal loss for the amount of service obtained, you have probably lost part of the material in one of these ways:

(1) During backwash. Check by looking for exchange material in the backwash sump. Losing exchange material during backwash almost always coincides with an excessive wash rate. (2) Through the strainer system. An upset supporting bed indicates this loss.

If you need further investigation, check the resin itself. Contaminants, like some forms of iron and organic material, may affect performance over a period of time. A slight trace of such a contaminant is not readily detected and may have a cumulative effect if it is not removed during normal regeneration.

Take samples of exchange material from various depths in the bed (0, 9 and 18 in. below the top) and send to the manufacturer for analysis. One-pound samples usually suffice. Pack them in clean, watertight containers.

There are procedures to treat the exchange material, while still in the unit, to return it to full capacity. To avoid a recurrence, you may want to install pretreatment equipment that will prevent the contaminant from reaching and getting into the ion-exchange unit.

Poor results. The quality of water obtained from the ion exchanger may decrease and fluctuate or hold steady at some level below normal. Before suspecting the unit itself, investigate possible external causes. Perhaps raw liquid is entering the unit's outlet line from another source, or is directly bypassing the unit through a faulty valve. Contaminants, as described above, can also cause uniformly poor results.

If you suspect contamination, collect samples of the ion-exchange material for analysis. But if a visual inspection shows that the bed is upset, investigate channeling first.

Channeling is caused by a varying resistance to flow through the horizontal cross section of the exchange-material bed. In a slightly upset bed, the supporting material and the exchange material form hills and valleys. These provide varying resistance to the liquid flow. Flow rate is greatest in low-resistance zones.

Exchange material in a low-resistance zone exhausts rapidly because it comes in contact with more liquid. In effect, exchange material in a high-resistance zone is bypassed. And subsequent backwashings aggravate the condition because the hills and valleys tend to reach greater extremes.

Channeling may be caused by: (1) Excessive backwash rate. (2) Pressure surges during backwash. Correct by installing a pressure reducer or surge eliminator at the backwash inlet. (3) Crusting at top of bed, caused by foreign particles that have cemented the upper zone of exchange material. Correct by physically breaking up the crust. Eliminate the cause by filtering the entering liquid. (4) Bed packed down by excessive service flow rate or extremely long service runs. Correct by physically poking and loosening the exchange material. The cause may be eliminated by backwashing whenever pressure drop across the unit increases 5 to 10 psi above the pressure drop observed when service run started. (5) Failure in the strainer system. Unload the unit and repair. (6) Cementing together of exchange material. Caused by precipitation resulting from incorrect regenerant strength. (Under certain conditions, calcium sulfate precipitates in a cation-exchanger bed when unit is regenerated with too strong a solution of sulfuric acid.)

Any one or any combination of these causes makes the liquid break through

Give your ion exchanger regular preventive-maintenance

No matter what equipment you are using, it pays to follow operative, preventive and corrective procedures recommended by the manufacturer. One way to help insure uninterrupted operation and high efficiency in water-treating equipment is to adopt techniques used by the manufacturer's servicemen.

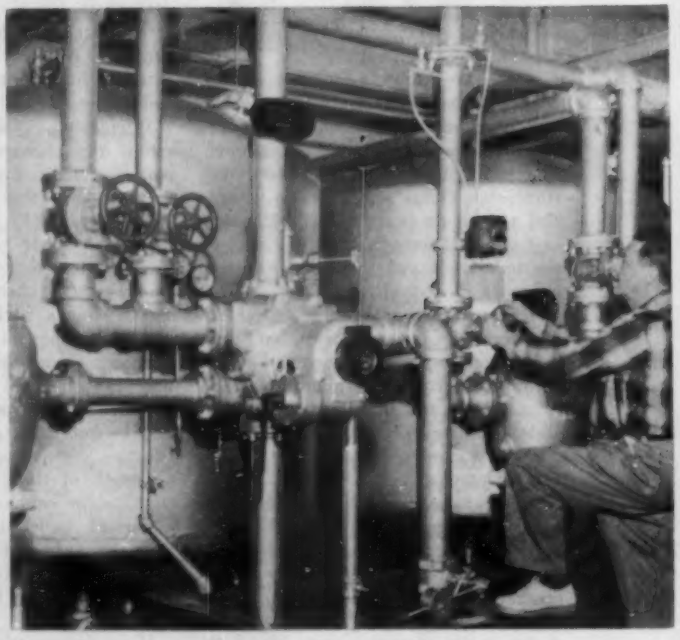
The best equipment is valueless if improperly maintained or operated. Yet poor operation is not always apparent immediately. Often you can only tell whether water-treating equipment is functioning properly by making chemical tests. Practically any operator can learn these simple tests in a few minutes.

One basic procedure is keeping a performance log so any irregularity becomes obvious. For installations where recorders keep the log automatically, operator's task is minimized. See text above for items to record.

Set up a regular maintenance schedule for water-treating equipment. Open up filters, zeolite water softeners, ion exchangers, etc, at least once a year. Probe the beds and examine shells internally for signs of corrosion or other damage.

Also, make routine checks and inspections of control and auxiliary equipment. These measures are important, yet often neglected, mainly because (1) they are simply and easily made and (2) it is seldom that anything gets out of adjustment.

Photographs at right show three steps in preventive maintenance: (1) checking auxiliary pretreatment filters (2) inspecting automatic electrical controls (3) checking automatic hardness tester. Text beginning p 112 gives details on trouble-shooting and corrective maintenance.



CHECKING flow rate through auxiliary pretreatment filters is one important step in a preventive-maintenance program

the bed at one or more points during backwashing. Flow at the break-through points is greater than at others, and channeling results.

Low flow. Several things decrease the flow delivered. None of them has anything to do with the unit itself.

An excessive pressure drop indicates trouble. If unit is new, or has recently been opened, check whether cloth was left inside during inspection. In one case on record, a worker actually left his overalls inside the unit.

But if pressure drop is normal, look elsewhere for the trouble. Check the entering liquid pressure and any possible restriction like faulty valves, foreign material in pipelines, and restrictions in the equipment that receives the treated liquid.

Unloading anion exchanger. Unless the unit is small enough to be turned on its side, unloading is time consuming. A man has to enter the drained unit and pass the exchange material out in buckets. But there are two alternates to digging out manually.

One method, see sketch *A*, p 113, uses an ejector to suck the exchange material up and out. During this operation, open the upper manhole cover and backwash at a very low flow rate —just enough to fluidize the bed. The backwash liquid overflows through the manhole. Lower the suction end of the water-operated ejector into the unit. It draws up a slurry of exchange material.

Another method, sketch *B*, p 113, requires fitting a pipe to the manhole cover. Pipe reaches down into the exchange-material bed and terminates at the center and about 3 in. above top of the supporting material. As in the previous method, backwash the unit at a very low rate to just fluidize the bed. Since backwash rate is low, permitting liquid to leave through this vertical pipe will force any exchange material near the pipe end to leave too. Find the maximum amount of "carryover" by varying backwash rate and observing results.

In both systems of hydraulically emptying an ion exchanger, the flow from the unit must go to a collecting tank. There the exchange material sinks to the bottom and the liquid overflows. When all possible exchange material is removed in this way, drain the unit. Then manually remove the remaining material, and all the supporting bed.

Sometimes you can correct a slightly upset bed without unloading. This involves backwashing at a high rate to fluidize the lighter zones of the supporting bed. While the procedure has met with some success, it is a gamble that may aggravate rather than correct an upset bed.

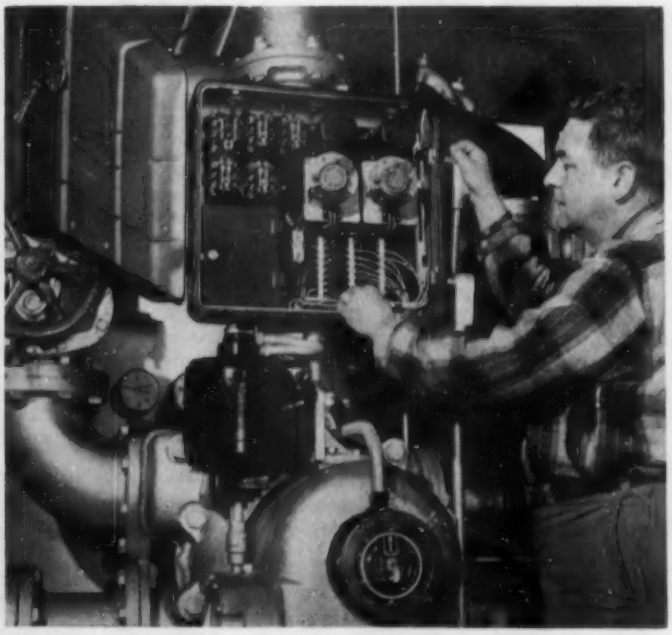
For best results, try this method only after deciding to unload. Then, if it does not correct the upset bed, you have lost nothing. Make provision to recover the exchange material as it is washed out.

Keeping a log. Best and most inexpensive way to correct any trouble is by not letting it develop. Keeping a log up to date as a matter of routine will uncover any trend toward unsatisfactory operation.

Record items like ion contents of raw and treated liquid, gallons of liquid treated between regenerations, pressure drop against the unit and consumption of regenerant solution. These will serve as an accurate means of measuring performance. Most manufacturers gladly comment and make recommendations on the basis of log sheets.

If qualified personnel are not available to inspect the installation regularly, you may find it advisable to check with the manufacturer about the types of service contract available. Service can be tailored to meet requirements.

checks to help in avoiding serious operating troubles



AUTOMATIC valve control must work smoothly. It provides the "brains" that send exchanger through regeneration steps

HARDNESS TESTER makes automatic soap tests at intervals. It activates automatic control valve when water tests hard

By MICHAEL A STEVENS, *diesel engineer*

14 Diesel Q&A

on today's maintenance and operating problems

Q 1—Some engineers renew connecting-rod bolts at set periods as a preventive measure. Is this necessary?

A—Experience shows it's good practice to renew these bolts whenever a piston seizes. During seizure, bolts are subjected to excessive stresses. Reason: They are not designed to stop the flywheel rotation suddenly and, at the same time, absorb forces being developed by combustion in other cylinders under such conditions.

If not under higher stress than normal, a modern well-designed alloy-steel connecting-rod bolt need not be replaced during engine's working life. Some manufacturers recommend renewing these bolts after so many hours of service. Time they suggest varies from 10,000 to 30,000 hr. But usually they don't take engine's speed into consideration. If engine runs twice as fast, bolts naturally do twice as much work. So total rpm and not engine hours should be deciding factor in the first place.

Changing bolts is a safety measure, usually for plants without trained diesel operators. Some engineers inspect root of connecting-rod bolt threads for hair cracks. These are caused by fatigue and should be watched.

Q 2—Are shims of various thicknesses as reliable in connecting-rod bearings as one solid shim?

A—One solid shim is more rigid. It does not have the deflections of many thin shims. It's best to use only one thick shim here because this bearing really takes a beating if there's any give in the shims. Use one solid shim of the laminated type. Then you can peel off a thin sheet to take care of wear when overhauling bearings.

Another bad feature in using many loose, thin shims is that they get dirty, burred and bent. They may seem tight when bolted together, but such shims, by causing bearings to loosen under constant pounding, can wreck engine.

Q 3—What are some causes of dry-cylinder liners that lead to piston seizure and costly engine damages?

A—Operators often overlook the fact that after an engine has been idle for some time lubricating oil drains away. A little of the oil may get trapped between piston rings and cylinder liner. But seizure often starts if cylinder liner is dry when starting. This takes place before oil is supplied by lubricators or before it splashes up from crankcase.

Answer is to turn engine over slowly a few revolutions so all parts are thoroughly lubricated. If engine has a hand pump, always charge lube system with it before starting engine.

Of course, a very common cause of piston seizure is stuck piston rings and combustion gas blowing past them, burning lube oil off cylinder walls.

Q 4—What are some causes of lost power in a diesel engine?

A—Engine may gradually lose power from cam wearing, timing chains or gears wearing, injection timing being retarded, or faulty fuel-oil spray, etc. Because engine wears gradually with use, some operators give it the original acceptance tests every few years.

You can't always tell work that each of the cylinders does by comparing their exhaust temperatures. Leaky exhaust-valve increases exhaust temperature also. Some of the other reasons for unbalanced exhaust temperatures are: defective spray, filter choking off air supply, retarded injection.

Best way to find cause of high exhaust temperature is to use an indicator. With a little experience, an alert operator can tell many engine faults by studying indicator cards.

Q 5—What are some engine governor faults to check from time to time?

A—Governors may tend to hunt. Cause is usually from lost motion due to wear. Hunting can cause rapid governor wear and may even fracture the spring attachment. Wear

on the weights' fulcrum pins may be excessive from bearing on same spot, or because these parts don't get oil.

Balls in ball bearings of governor tend to bed into the race at normal working positions. This is known as false Brinelling. This condition has caused governors to fail when load is suddenly removed. Check ball bearings on your governors and renew them if they show signs of this fault. See p 144, Aug POWER for info on false Brinelling.

Q 6—How does change in fuel-injection timing affect firing pressures?

A—Early combustion before piston reaches end of compression stroke is from too-early fuel injection. Or, if combustion is greatly delayed, pressure rise in cylinder is abnormally high.

Then shock is hard on bearings, cylinders and piston rings. Fuel timing must be right for engine condition, grade fuel used, altitude, water-jacket temperatures, etc. Otherwise, engine will knock.

Q 7—When do early and delayed combustion knocks occur?

A—Both take place while diesel piston is at top end of compression stroke, or before piston starts down on power stroke. In either case, entire engine-cylinder assembly is abnormally strained.

Spark-ignited engine causes a knock, usually referred to as detonation. This takes place when piston is in lower portion of cylinder. Detonation is usually caused by final explosion of accumulated, unburned fuel because of incorrect air-to-fuel ratio or ignition qualities of fuel.

Q 8—Diesel may knock when piston is at top end of stroke from high pressure rise per degree of crank angle. What causes this condition?

A—There are a number of causes: (1) Ignition lag is too long, resulting in delayed combustion from low compression. Low compression is usually from leakage past piston rings. (2) Fuel that is poorly atomized also causes delayed combustion. (3) Jacket-water temperature is too low. (4) Air-to-fuel ratio may be incorrect. (5) Fuel-injection timing may be incorrect because of overloading, causing too early combustion. (6) Engine may be out of balance, causing too early combustion in some cylinders. (7) Another cause of incorrect injection timing may be from fuel timing set incorrectly for grade of fuel used, giving too early or too late combustion.

Q 9—What are some reasons for high lubricating-oil consumption in a diesel engine?

A—Common cause is too much lube oil reaching cylinder walls, where it's spread into combustion area and burned. This often starts from excessive bearing clearances, which lower lube-oil pressure because oil leaks out of such bearings. Then operator increases oil volume at pump to bring up pressure. This may hold bearing temperatures right, but it floods cylinder walls.

Another reason for high lube-oil consumption is ineffective oil-ring control. Under this heading look for: excessive piston clearance, cylinder or ring distortion, worn cylinder or rings, insufficient ring gap, stuck piston rings, scraper edge of oil ring worn round, or clogged oil ring.

Third reason: New oil in engine may be too light or lube oil may be diluted with fuel oil. High oil temperature, oil leaks, wrist-pin plates not oil tight, excessive suction on crankcase breather or light-load operating conditions—all boost lube-oil consumption of your diesel engine.

Q 10—What are advantages or disadvantages of the positive-displacement-type scavenging pump over blower (centrifugal) type?

A—Positive-displacement type has some advantages over centrifugal type. For one thing, displacement volume is not affected by humidity, variations in barometric pressure or temperature. Also, positive-displacement blower responds immediately to changes in engine speed when engine driven. These blowers are usually engine driven, and power for driving decreases as engine speed decreases.

Q 11—Explain how to measure the compression pressure in diesel cylinders.

A—Cut off fuel from one cylinder at a time and indicate that cylinder with an indicator, while running remaining cylinders on fuel or starting air.

Q 12—How do you adjust engine compression pressure?

A—Decreasing linear clearance between piston and cylinder head lowers compression pressure, while increasing clearance raises compression pressure.

Changing the compression pressure depends on the engine. Easiest way to do this on large engines is to remove or add shims under the connecting-rod foot. That lowers or raises the piston. Compression pressures rarely have to be changed. If they do, it's just a case of decreasing space between cylinder head and piston so air is crowded into less space—raising its pressure.

Q 13—Do diesel cylinders corrode and pit, or is all the lost metal due to wear?

A—Corrosion in internal-combustion cylinders is often indicated by a pitting of the metal surfaces. At times this pitting is visible to the unaided eye, but frequently only under magnification. Often corrosion is indicated only by higher-than-normal wear rates of cylinders and piston rings. Corrosion wear may be heaviest at top of compression-ring travel or at lower part of cylinder.

Here's reason why corrosion in cylinder is often taken for wear. When a metal surface is attacked by corrosion, a film of corrosion gets thicker and protects underlying metal. This slows rate of corrosion attack. But in engine cylinder, rubbing action of piston rings on cylinder walls continuously removes corrosion products as they form. So new metal is exposed for further attack. With this condition, operators often attribute high rate of lost metal to wear only, overlooking corrosion.

Most corrosion trouble in engine cylinder is from combustion process. Examine gaseous materials present during and resulting from combustion if corrosion is bad—or wear rate is high.

Q 14—Does a 2-cycle diesel need same size flywheel as a 4-cycle?

A—No. Two-cycle engines have smaller flywheels than 4-cycle engines.

Usually the more cylinders, the smaller the wheel. There are exceptions to this general rule.

Diesel has relatively high ratio of maximum pressure to mean pressure in cylinder. While inertia smooths this out, turning moment impressd on shaft is irregular and these engines need fairly heavy flywheels to smooth out jerky turning moment.

Slow-speed engine naturally needs heavier flywheel than high-speed engine. Another consideration is the ac generator unit that must run in parallel. In this case, flywheel size is also based on electrical factors.

By H H MILLER, *Consultant*
Compressed Air and Gas Institute

Your 6 steps to better compressor choice and hookup

1 **Figure capacity needed**

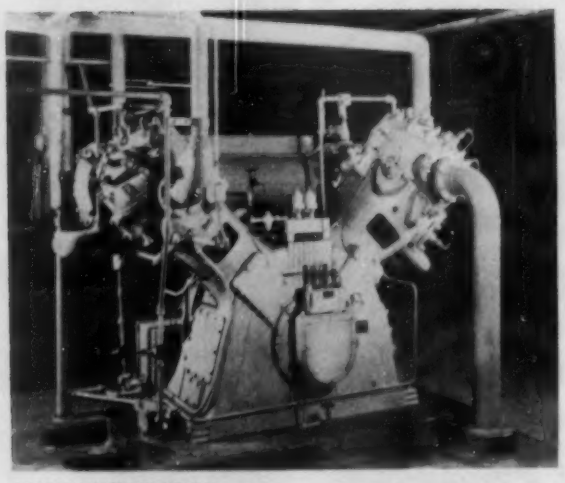
2 **Pick number of units**

3 **Locate compressor right**

4 **Choose a good drive**

5 **Size pipes liberally**

6 **Use enough accessories**



SINGLE INSTALLATION: modern reciprocating air compressor

► FINDING THE CAPACITY NEEDED for a compressed-air system is much like adding the change in your pocket. Make a list of each tool and device to be supplied air. Opposite the tool name mark the air consumption for continuous use. (Get this from tool catalogs or manufacturer's engineer).

Tool use. You'll find that, while some tools run almost continuously, most run intermittently. For instance, in a plant having ten chippers, probably only a few run continuously. And when a large number of different kinds of tools are used, like chippers, hammers, hoists, blow guns, you can expect that not all will be used at the same time. So the net air consumption under normal conditions is usually much less than the sum of the continuous needs of all the tools.

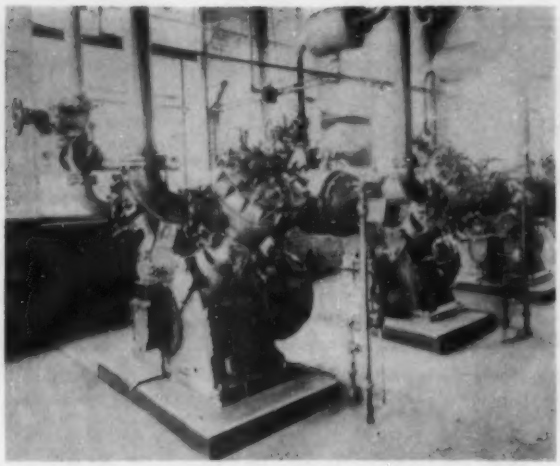
The number we use to multiply the continuous needs of all tools to obtain our actual load is called the load factor. The greater the number of tools of any type, and the larger the number of types used, the lower the load factor, usually. Load factor will, of course, vary from one plant to another, with type of work, etc. It must be carefully estimated.

Another item affecting the amount of air needed by a tool is the kind of work being done—this fixes how hard the user must force the tool. A grinder or drill running in hard material needs more air than one running in soft material. In the trade this is called the work factor and should be considered when figuring the total air needs.

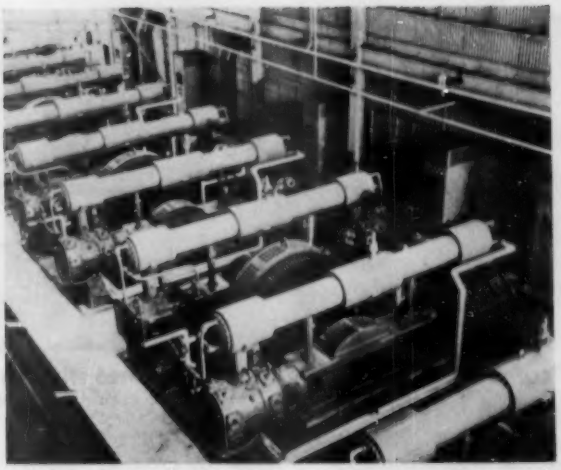
Load factors for a new plant aren't easy to estimate. Tool manufacturers are helpful, and should be consulted. From their experience with similar work they give you a close estimate of the actual factor. Also, a rough check can often be made with other plants doing the same kind of work. Make comparisons on the basis of the tonnage handled, as well as the number of men working in production. Though this scheme isn't too accurate, it gives you another check on capacity.

When you're figuring load factors for an addition to your existing plant, the task is much easier because you have the data from the original installation. Use them as needed, making any changes experience shows are needed.

Large tools, like jarring and molding machines in foundries, air hoists and lifts, forge hammers, must be carefully figured. They may require such large quantities of air that the entire shop pressure may be upset while these tools



MULTIPLE INSTALLATION of modern reciprocating compressors



BIG HORIZONTAL UNITS supply air to major production plant

are used. Consider locating large air receivers at the tool. Though a receiver can store only a small quantity of air it is useful in taking care of instantaneous peaks. Often you can arrange to run large air consumers during off hours, as when the machine shop is closed. This avoids the need to install an abnormally large compressor for normal plant services.

Another way of handling large air quantities is to use low-pressure air from another system, like sand blasts. If the sand blast can be shut down while the large unit runs, a small booster compressor can be installed to raise the pressure of the low-pressure air to the regular shop level. You must plan a hookup like this so no other work in the plant is penalized.

Leakage must also be considered, especially if the air distribution system is large. Though all distribution systems should be air tight and free of leaks, in practice they seldom are. Often leaks that develop aren't repaired as soon as they should be. It's a good idea to have an operator walk through the plant once a week during the noon hour to listen for "birdies" (air leaks). Repair them at once. Don't let anyone talk you out of allowing 5 to 10% margin for leaks in the system, because few are kept tight.

You also need a safety factor for the accuracy of tool air consumption. Exact need can seldom be figured down to the last cfm. So add 5 to 10% for inaccuracies.

Load growth must also be planned for. There are two kinds—new uses for air in an existing plant, and actual enlargement of the production facilities. Where the plant is not expected to expand, but air uses are, allow 10 to 20% for growth of air uses themselves.

Compressor capacity. It's neither desirable nor economical to install too large a compressor. But this infrequent situation is less serious than being short of air. When compressor capacity is too small, air pressure drops. Excessive leakage also causes a drop in pressure and you should be careful to check for leaks when air pressure can't be kept up to normal. You can easily make a leakage test during the noon hour when no air is being used, by noting what capacity is needed to maintain normal shop pressure.

Undersize piping between the compressor and load is another cause of low air pressure. Reduced pressure should always be avoided because it decreases production and increases cost, which are constant daily losses. Amount of work done by air tools falls off rapidly as the air pressure goes below its normal level because the tool speed decreases. So the capacity of the compressor should be adequate to maintain normal air pressure nearly all the time. When normal pressure cannot be held and there are few leaks from adequately sized pipes, it is time to consider installing an extra compressor.

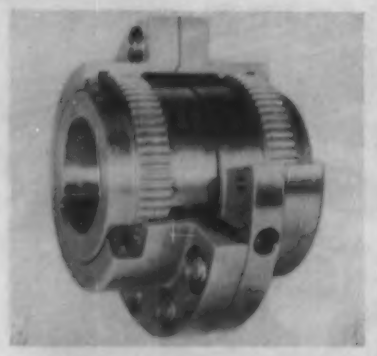
Night operation at reduced capacity is often necessary in some types of plants. It is worth considering a smaller compressor to satisfy the night load, permitting the larger day unit to shut down. The smaller compressor can also provide added capacity for peak day loads.

Choosing a small compressor for night loads requires careful study of the comparative operating costs. Large synchronous-motor-drive compressors for the day load might give better efficiency at light loads than a smaller compressor, if this is to be driven by a synchronous motor. And don't overlook the electric charge for connected load when the small compressor is added to the plant electric load. This shows, once again, that you can't be too careful in making sure your system is adequately designed from start to finish.

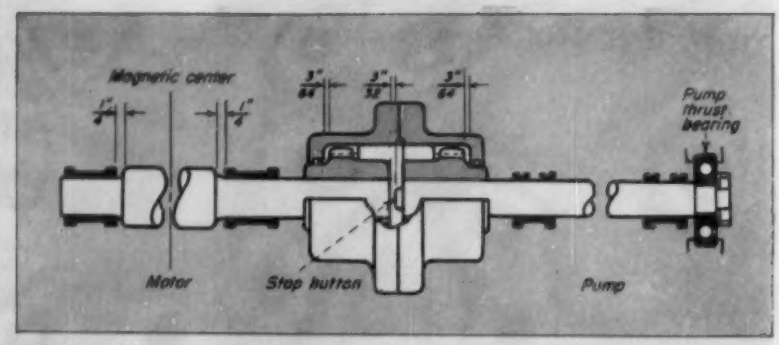
An important point, sometimes overlooked: The entire plant and its distribution system are based on the air capacity found during plant design. Any mistakes that produce an undersize system can be costly, requiring many major and expensive changes of piping, etc. It's better to err on the safe side than to install a plant with too small a distribution system.

How many units? Study is needed to find if a single compressor, or more than one, should supply all air. In smaller plants, a single compressor is usually chosen, unless production always depends largely on compressed air, as in glass manufacture. Here a standby is needed, even though the necessary capacity is small. With a large air need, say 3000 cfm, it might be worth considering two 1500-cfm compressors. If loss of air would cripple production, three 1500-cfm units would be ideal, giving a complete spare at all times. Guide should be the balance between increased first cost and the cost of production loss. The loss will vary from one type of plant to the next.

Our next article will discuss air distribution, etc.



CONVENTIONAL gear- or spline-type coupling is suitable for most applications



LIMITED END-PLAY coupling here lets motor shaft move only 3/32 in. toward pump, or toward motor outboard bearing. So thrust collar can never contact the bearing

Engineers using horizontal centrifugal pumps often ask whether to adopt conventional or limited end-play couplings. The answer is that each has a specific field of application, and . . .

Employing limited end-play couplings

► To DECIDE whether to choose a conventional or a limited end-play coupling, you must know what each type does. We'll discuss operation, then go into reasons for using each.

Conventional couplings. Conventional gear- or spline-type couplings consist essentially of two identical geared hubs. One is keyed to the driver and the other to the driven shaft. An internally geared floating cover transmits torque from one hub to the other.

Such couplings are entirely suitable for most applications. But under certain conditions their construction lets thrusts remain unchecked. This can harm sleeve bearing motors.

Most motor rotors throw to one end or the other in starting. Since standard sleeve bearing motors do not have thrust bearings, a shoulder or thrust collar formed on either end of the shaft limits endwise travel of the rotor.

If motor runs free or under a belted load, rotor finds center of the magnetic field. But when it drives through a conventional gear- or spline-type coupling end thrust required to telescope the splines may be greater than the recentering force developed by the axially displaced rotor. Contact between thrust collar and babbitt bearing results. If such contact is prolonged, motor bearings may score or burn out.

Some factors contributing to coupling's inability to telescope properly: high unit pressure on the gear teeth, insufficient lubrication, wear, misalignment. Using a limited end-play coupling compensates for these factors.

Limited end-play couplings have mechanical stops that limit axial motion of driver shaft in relation to driven shaft. In addition, coupling transfers the low motor thrust, caused by magnetic unbalance, to the pump thrust bearing.

Some manufacturers offer specially designed limited end-play couplings. But the usual method of restricting travel is to use a standard coupling and limit motor shaft's float toward the pump with a stopbutton inserted in end of the pump shaft. Clearances between gear hubs and internal faces of the coupling cover limit motion away from the pump.

Total travel allowed must be less than the total clearance between motor-shaft stop shoulders and the bearings.

Sketch above shows a limited end-play coupling between a pump and motor. Total rotor end play is ½ in. and the coupling end-play limit is 3/16 in. With the rotor in its magnetic center, pump shaft stopbutton lets motor shaft move 3/32 in. toward pump. If throw is away from pump, gear casing restricts motor shaft's axial motion.

When gear hubs are against the casing, motor shaft can travel 3/32 in. toward motor's outboard bearing. So thrust collar would never be closer to the bearing face than 5/32 in. Coupling limitation depends on the rotor end float.

Telescoped couplings. Starting torque of any standard horizontal centrifugal pump is low because of the inherent pump characteristics. Unit is usually started against a closed discharge valve, with power input to the pump relatively low. Then discharge valve is gradually opened until pump characteristic coincides with the demand set up by the system and full-load torque is required for continued operation.

With the motor switch closed, the only torque developed immediately is that required to break pump shaft away from the bearings and start pump turning. This is 10 to 15% of full-load torque—not enough to prevent coupling parts from telescoping.

But during this period the axial thrust, or expelling force, of motor is at its peak. This thrust can telescope the coupling, which at the moment is under a low load.

Recommendations on coupling motors to pumps

Here are standard recommendations for coupling motors to fluid pumps, prepared by the Hydraulic Institute and NEMA.

1. Provide motors with ball bearings wherever applicable, particularly for ratings 100 hp and below with synchronous speeds 3600 and 3000 rpm; 200 hp and below with synchronous speeds 1800 rpm or less.

2. Where motors have sleeve bearings, apply the bearings and limited end-play couplings as shown here:

Motor hp	*Synchronous speed, rpm*	*Min rotor end float, in*	*Max coupling end float, in.*
125-200	3600 & 3000	¼	3/32
250-450	1800 & below	¼	3/32
250-450	3600 & 3000	½	3/16
500 & higher	All speeds	½	3/16

3. To facilitate assembling pumps and motors rated 250 hp and higher, motor manufacturer should (a) indicate on motor outline drawing the minimum motor end play in fractions of an inch (b) mark rotor end-play limits on motor shaft (c) show maximum lathe center dimension on the outline drawing of the motor.

4. When assembling a sleeve-bearing motor and a fluid pump, connect so pump's thrust bearing holds the motor rotor and leaves some endwise clearance in the motor bearing under all operating conditions. Difference between the rotor end play and end float in the coupling allows for (a) expansion and contraction in pump (b) clearance in pump thrust bearing (c) endwise movement in the coupling (d) assembling pump and motor.

By G V SHAW, *Cameron Pump Division, Ingersoll-Rand Company*

saves motor bearings — sometimes

As pump accelerates and pressure increases to maximum, torque on the coupling increases to about 60% of full load. Finally, as discharge valve opens, torque increases to full load. Then rotor may not develop enough axial thrust to regain its magnetic center. So the motor shaft shoulder stays in contact with the babbitt bearing face, unless you use a limited end-play coupling.

Hot-liquid pumps. In pumps handling hot liquids, like boiler feedwater and hot oil, the condition may be aggravated unless pumping unit is specifically designed for the application. Such pumps are anchored to the base on the coupling end. Then practically all casing and shaft expansion is away from the coupling, toward unit's outboard end. Without such provision, heat expands the pump shaft away from thrust bearing toward the coupling.

Initial rotor displacement may make the motor-shaft collar contact the stop on end opposite coupling. Then, if coupling is transmitting full load and the recentering force can't telescope the splined coupling, collar will keep on turning against stop. Pump shaft expansion increases load on pump thrust bearing as well as on motor bearing.

In this case, a limited end-play coupling would restrict rotor throw toward the outboard end, and collar could not contact the bearing. But be sure to consider the pumpshaft expansion when setting limits for coupling end play.

Geared units. High-horsepower boiler-feed pumps frequently use stepup gears between pump and motor for reasons of economy. Double helical gears, which generate no end thrust, are usually furnished for this service. But the gears are also exposed to thrust forces transmitted through the coupling. Gear could be furnished with a thrust bearing at considerable extra cost. This would compensate for the combined thrust loads imposed by motor and pump. But using two limited end-play couplings is simpler. One is installed between motor and gear, the other between gear and pump, thus transferring total thrust to the pump thrust device.

With three pieces of equipment involved, take great care in determining (1) limit of travel for each coupling (2) minimum end play between motor-shaft stop collars and bearings. Also, locate individual parts of the unit with great accuracy.

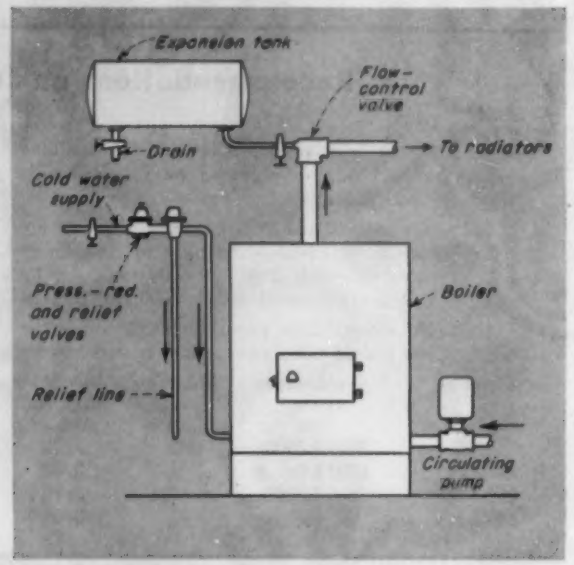
Bearing troubles. There are few bearing troubles in motors rated below 200 hp. In this range, most motor manufacturers use ball bearings that definitely limit rotor end travel and absorb thrust imposed by motor, gear-type coupling and pump.

With sleeve-bearing motors below 200 hp, couplings are generally large for the power transmitted. Then unit pressure on the teeth is not high enough to prevent a properly lubricated coupling from telescoping. But improper lubrication and wear may cause trouble.

Both builders and users of motor-driven centrifugal pumps have long recognized this problem. One solution is to add a thrust bearing to the motor. While this way may be desirable from the pump manufacturer's view, it is not feasible when you consider the number of motor builders. And it would require much development work to make such a change in all the motor frames involved.

The simpler, generally accepted solution, is to install a limited end-play coupling between motor and pump. Most, if not all, pumps have thrust bearings with enough capacity to carry the motor thrust. See data, top of page, for recommendations on coupling motors to pumps.

By F FEIGENBAUM, *Applications Engineer*
Barrow Oil Burner Corporation



1 Conventional location of equipment in automatic, closed hot-water heating systems. Radiators are on upper floors

To avoid frequent venting, draining problems . . .

Keep hot-water heating-system

► Air in hot-water heating systems can be useful or troublesome—depending on what part of the system it inhabits. And if the right steps aren't taken, it'll show up where you want it least. For instance:

During the same day, the maintenance man sometimes finds himself venting top-floor radiators and draining the closed expansion tank downstairs. Chances are, if he doesn't understand what's happening inside the system, he probably wonders how the air managed to get down from the tank and up to the radiators.

In old-fashioned open-top systems the "misplaced air" problem was simpler. Chief trouble with this type: It lost water by evaporation, replaced water with air in upper part of system. Water might be added and radiators vented several times during the heating season.

Closed system eliminates this nuisance. Pressure-reducing valve feeds water automatically, maintaining system pressure great enough to hold water in highest radiators. Thermal expansion increases this pressure. So a relief valve is set at about 30 psig to hold upper limit. Water contraction, on cooling, reduces pressure. And inlet valve makes up the loss.

This arrangement works fairly well with gravity circulation because water temperature changes are small, gradual. But upper-radiator air binding isn't completely eliminated. Small quantities of air come in with fresh water during each cooling period.

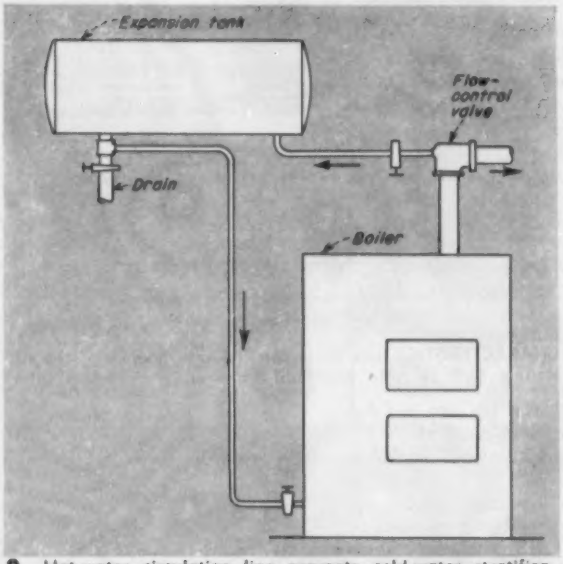
Automatic heat distribution by motorized valves and circulators made the reducing and relief valves hard-working members of the heating team. They were called on to perform 20 or more times a day in response to pressure, temperature changes. Result: Increased water flow, through these valves, brought with it more dissolved solids, gases that could foul the working parts.

Closed expansion tank reduces the constant exchange of water (and its impurities) by providing an air cushion. Water expands against this cushion when heated and is pushed out into the system by air pressure when cooled. If tank is right size, system pressure never reaches relief point. So no additional water enters system.

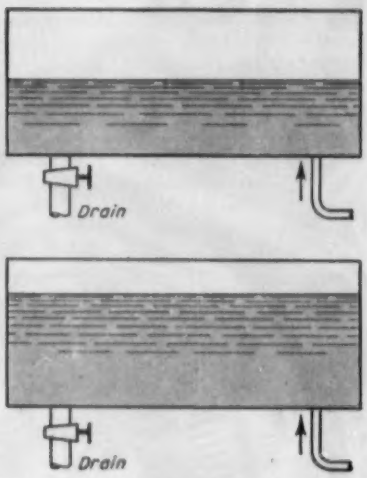
You'll generally find the expansion tank at a high point above the boiler, Fig. 1, connected to a high part of the main, or to the flow-control valve itself. It traps a volume of air when you fill system. And because of the location it should continue to trap any new air released by heated boiler water. But in many systems some air finds its way to the upper radiators.

This air would act much as air in the expansion tank does to provide a cushion against expansion during the heating period. But it blocks effective heat transfer and must be vented out of the system. Air's volume is soon replaced by new water containing additional air. This process goes on continually during the heating season.

Meanwhile, another condition operates to prevent stability of the system's air-water balance. The expansion tank receives little heat from the boiler, radiates most of it. Since tank is cool



2 Hot-water circulation line prevents cold-water stratification in expansion tank. Return line goes to low point



3 Volume of water and air in tank at 15 psig, *above;* at 30 psig, *below*

air in your expansion tank

and at fairly high pressure, water in it gradually absorbs the air. This air is lost during cooling cycles as water passes back down the expansion pipe and into the system. Process, carried to its limit, can yield a stabilized condition with tank full of water and no flow through expansion pipe.

When tank is completely filled with water, you have no air cushion. You're back to the no-tank system, discharging water with every heating cycle, calling for new water during cooling periods. New air soon finds its way to the upper radiators and a frequent venting problem develops. In fact, the condition begins to develop long before the expansion tank is completely filled with water.

Draining the expansion tank is the immediate remedy. But it isn't the cure. Best way to get at core of the trouble: Keep the tank warm so it can't reabsorb the air cushion. A hot-water circulating line, Fig. 2, does the job.

Undersized expansion tanks can lead to frequent need for venting at the radiators. In sizing the tank remember that its entire volume isn't available for expansion. You're compressing original air in the tank when filling the system. If the highest radiator is 35 feet above the tank, for instance, more than half the tank volume is occupied by water —even before heating, Fig. 3. Since pressure-reducing valve is set higher than actual pressure needed, you can count on only 40% of the tank's space for thermal expansion. So it's futile to accurately figure expansion volume needed and order a tank of this volume. Chances are, you'll be in error by about two and a half times.

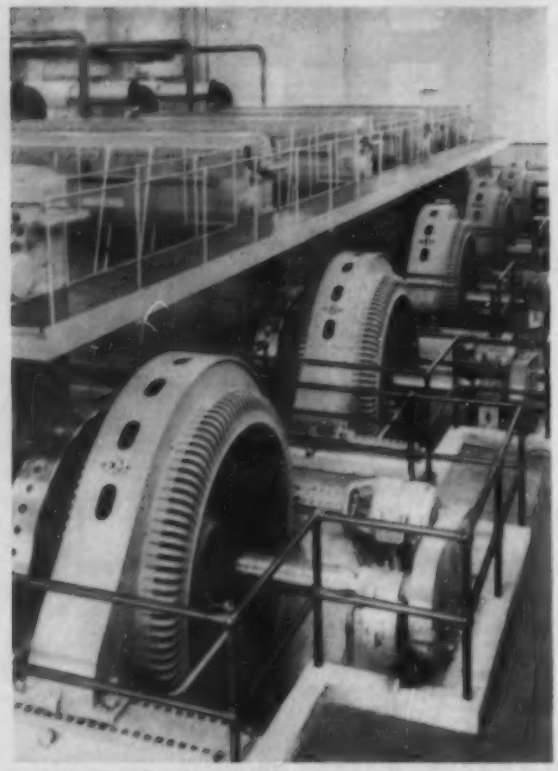
Cure for an undersized expansion tank: Install another of equal or larger size. You don't have to remove the original tank, or even the water from the system.

Here's a simple way to measure how much more expansion volume your system needs. Measure discharge-water volume from the relief valve during early morning operation. This is the needed additional receiving space. But it isn't the actual tank size. Add to this figure air-cushion space.

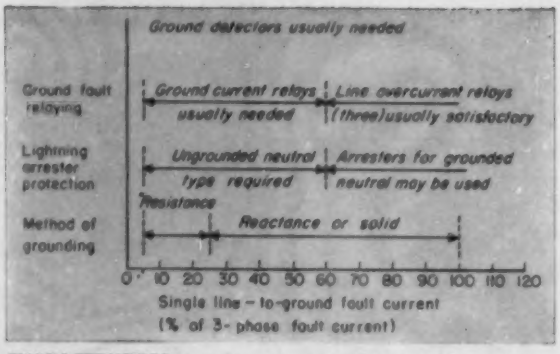
Where you're dealing with very high systems, relocate the expansion tank at top of the system. Here it has maximum capacity and smallest pressure rise. Relief valve discharges less often or not at all. And new water needed drops off. So less air enters the system.

These two steps, maintaining captive air in the expansion tank and avoiding entrance of new air to system, reduce or eliminate air-venting problems in conventional up-flow heating systems. As a byproduct gain, you'll avoid solids formation in the pressure-relief valve due to discharging large quantities of water.

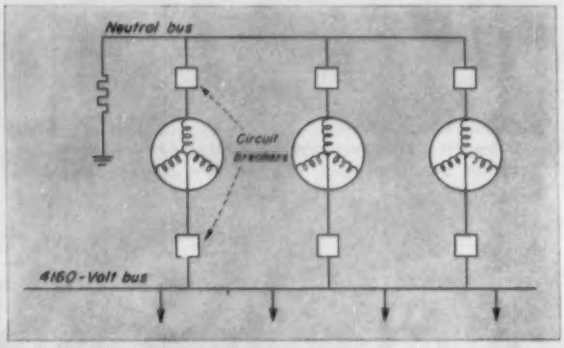
Important also from layout and maintenance viewpoints: (1) Pitch all piping to keep air in system from being vented through radiators, open tanks and external relief valves. (2) Make sure the entire system is free from leaks. Even small leaks can make repeated expansion-tank charges necessary. (3) When changing size of horizontal pipe run, use eccentric fittings to keep top of pipe in line. These allow movement of air along pipe.



RECOMMENDED PRACTICE in most installations leans toward grounding generator neutrals, and using resistors or reactors


Ground detectors usually needed
Ground fault relaying
Ground current relays usually needed
Line overcurrent relays (three) usually satisfactory
Lightning arrester protection
Ungrounded neutral type required
Arresters for grounded neutral may be used
Method of grounding
Resistance
Reactance or solid
0 10 20 30 40 50 60 70 80 90 100 110 120
Single line – to-ground fault current
(% of 3- phase fault current)

CHARACTERISTICS here for various neutral grounding schemes include both relaying and lightning-arrester protection setup



TYPICAL ARRANGEMENT: three similar generators connect to a neutral bus, using individual breakers in each machine neutral

Knowing the real reasons for grounding generator neutrals, in both industrial and municipal units, can be helpful in thinking through many knotty electrical operating problems

The right way to ground generator

► QUESTION of grounding electrical-system neutrals in municipal and industrial generating plants is as old as 3-phase power itself. In brief, the recommended practice today is to ground the neutral of most systems.

How to ground. Reasons for grounding are listed in box, facing page. The how-to side of the picture is pretty well agreed on throughout industry. In short, plants with line-to-neutral loads, like 4160-v systems with 2400-v single phase, use a low-impedance neutral reactor. Important consideration here is preventing overvoltage on unfaulted phases in ground faults. Some slow-speed generators have enough reactance to be grounded direct. But for high-speed generators, especially turbine-driven 2-pole units, reactor must limit fault current to same value as for balanced 3-phase fault.

Systems with no line-to-neutral loads, and little exposure to lightning use a higher neutral-grounding impedance to reduce fault current and burning at fault point. Here a practical reactor size is one limiting fault current to 25% of the 3-phase fault-current value. Using reactors with higher impedances will lead to transient overvoltages that are dangerous, should be avoided.

Resistors can be installed in such systems without risk of false operation if they are sized to limit ground-fault current to about 5% of 3-phase fault value. If only feeder overcurrent devices are used resistor size must be such that ground-fault current permitted is but slightly higher than tripping current of heaviest feeder.

Low-voltage systems, 600 v and below, generally have their fault currents limited to a comparatively low value by resistance at fault itself plus feeder impedance. Thus low-voltage systems are generally solidly grounded—except where low-ohm generator neutral reac-

6 reasons for grounding generator neutrals

1. Avoid inconvenience, damage from multiple faults that may result when single ground faults are not cleared promptly on an ungrounded system.
2. Detecting and locating ground faults on ungrounded systems cost money. If generators are neutral-grounded, fault literally smokes out the location.
3. Neutral grounding prevents transient overvoltages that may puncture motor insulation.
4. Voltage on unfaulted phases will be held in check during ground faults if neutral is properly grounded.
5. Lightning arresters are less expensive, more effective, on grounded-neutral systems.
6. Above 5 kv, neutral grounding permits less costly cable.

By **BEN H SMITH**, *Electrical Engineer*
Electric Machinery Mfg Company

neutrals

tors are adopted to prevent fault currents exceeding the value established for a 3-phase fault.

Some older systems use but two overcurrent relays on each 3-phase feeder. And since a grounded system requires three relays it is often impractical to ground a 2-relay scheme. Objection is cost of adding a third current transformer and relay.

How many ground points? If a bus has several generators, the question often pops up of the number to be grounded. Often there are two large generators, or a large generator and a power transformer with at least one always in service. In such cases a grounding resistor or reactor is used for each of these major power sources. Where there are more than two similar generators, any two of which may be in use at any one time, the possible ground-fault current becomes quite high if each generator is grounded. Here a neutral bus is often used with a single reactor or resistor between it and ground.

Transient overvoltages may be set up when switching circuits have ground faults or a broken conductor swings intermittently against a grounded object. Circuit then consists of system inductance and capacitance to ground. You can get transient overvoltages up to six times rated voltage. Such transients have caused many insulation failures.

For reactance-grounded systems, transient voltage is held in check if ground-fault current is within 25% of 3-phase fault values. With resistance grounding, phase relation of ground-fault voltage and current prevents restriking. The transient voltage will not be excessive if the ground-fault current is held to 5% of the 3-phase fault current.

For either reactor or resistor grounding, ratio of the two fault currents (ground fault to 3-phase fault) must be at least 60% to use lightning arresters rated for grounded-neutral service. Further, to avoid excessive reactance in generator or transformer chosen as grounding point, kva rating of generator or transformer should be at least 0.75% of system 3-phase short-circuit kva.

Switching and protection. You can omit neutral breakers or disconnects when individual industrial-size generators are grounded. Actually, burning of core laminations would be reduced should a ground fault occur within generator, provided a neutral breaker were used and tripped by differential relays. Nevertheless, this offering of reduced damage is generally not worth the added expense. Connect differential relays to trip line and field breakers. If your plant uses a neutral bus with reactor or resistor between bus and ground, each generator should have a neutral breaker to isolate it from the bus when not in service.

Bear in mind that resistors and reactors in grounding service have definite current and time ratings. Yet during a system fault, the grounding device must remain in the circuit. So if an overload relay protects the grounding resistor or reactor, it should have a long time-delay, allowing other protective relays to operate first. Resistors or reactors must be enclosed to protect men against high-voltage hazards during fault conditions. A well-constructed fence, built on the job, is usually satisfactory.

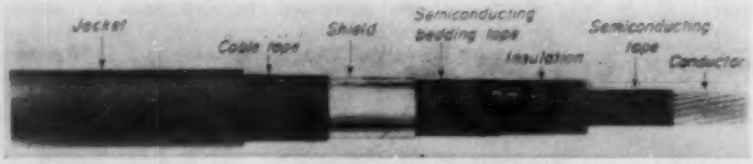
One basic factor must be kept in mind in reviewing generator grounding practice: Mechanical forces on a generator winding are proportional to square of the instantaneous current. Further, the short-circuit current through a grounded-neutral generator, because of a ground fault anywhere on the system, depends on system connections.

The maximum possible current in a 3-phase fault hinges on generator reactance. So to have a basis for general industrial practice, it is standard today among generator makers to guarantee their windings to withstand the current of a 3-phase fault. Resistor or reactor selected to ground generator neutral must limit maximum possible current to this value. Where several generators operate with a neutral bus and single reactor, latter's value must be at least equal to the highest calculated short-circuit value of the individual generators.

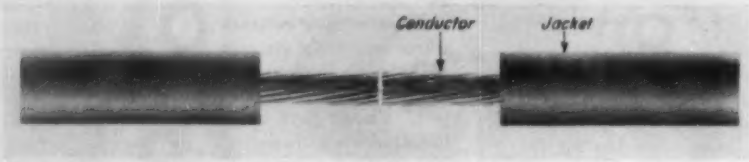
Resistor ratings. A 3-time rating is used today for neutral-grounding resistors. If the system is protected by relays, which operate to trip out all grounded circuits, a 10-second rating may be used. Where relays operate a signal or alarm only, the resistors may carry a one- or 10-minute rating: Naturally, size and cost of grounding resistors with a 10-minute rating are greater than for 10-second units.

Beyond this article's scope are the problems of: (1) supersensitive ground protection that provides indication if fault currents to ground are about 1% normal (2) ground protection for generators having power transformers between generators and distribution system. Aim in setting up the first protective scheme is generally to detect high-resistance faults before they develop into damaging ones. Also, same setup is considered for reduction of telephone interference caused by transient or harmonic ground currents in high-resistance faults.

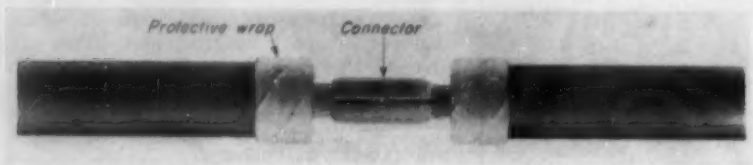
Such protection requires special directional relays and may be considered for municipal systems with considerable overhead distribution in residential areas. Industrial plants seldom need it. Second problem not covered in this article—ground protection of generators with power transformers between generators and distribution—generally calls for a generator neutral device to indicate a fault in generator windings or the leads. Many arrangements of small distribution transformers with resistors and voltage relays are used.



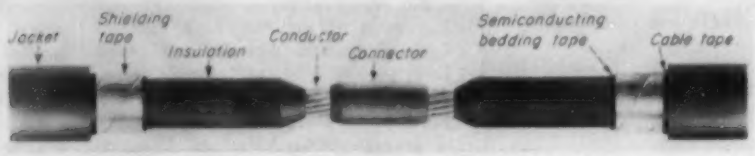
1 Be familiar with cable construction details before checking on any step in the jointing operation. Shielded rubber-insulated cable is used here throughout



2 Train cables in place, check available space. Completed joint has an approximate over-all length of: 18 in. for 5 kv, 22 in. for 12 kv, 24 in. for 15 kv



3 Protect jacket, insulation during soldering by wrapping with cotton or asbestos tape. Compression-type connectors must be used with aluminum-conductor cables



4 Remove jacket, cable tape: 4 in., 5 kv; 5 in., 8 kv; 6 in., 12 kv; 7 in., 15 kv. Remove shielding tape to within 1 in. of jacket. Take off all underlying tapes

Checking a new job? Here's your guide to . . .

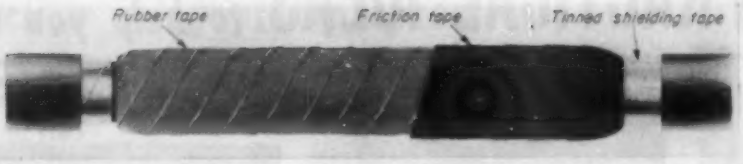
Splicing neoprene-jacketed cable

► YOU MAY NEVER have spliced a cable and you probably never will. But you should know enough about the key steps in jointing a truly modern cable. This will prove an aid in checking work done around your plant, either by your own men or outside contractors. The boiled-down facts under the photos, even with the supplementary information that follows here, is far from enough to make you a cable splicer. It's not aiming to.

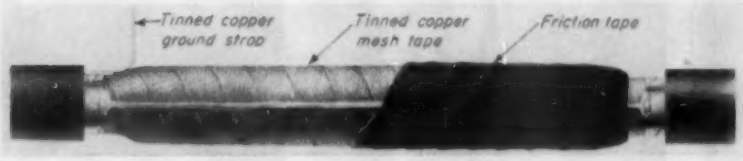
This info is for jointing *shielded* rubber cable. For *nonshielded* rubber cable just skip the shielding comments.

Conductors should be cleaned, flux applied, butted together inside connector before soldering. After soldering it, splicer should polish connector with grinding cloth. This is a must as burrs cause corona discharge, joint failure. No voids should be left after connector is compressed: Fill indents with solder or semiconducting material.

Note inch values for jacket removal, Fig. 4; these are for grounded systems.

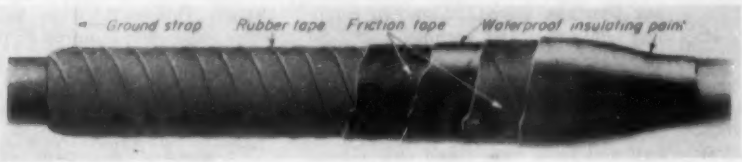


5 Reinsulate with self-bonding rubber tape. Measure connector diameter, then coat connector, insulation, jacket with rubber cement. Do not tape over shielding

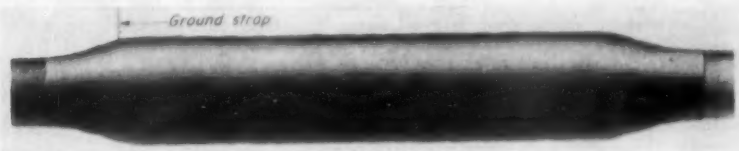


6 Shield joint with tinned all-copper-mesh tape. Wrap it from center to each end. Overlap at center, solder as here. Solder ground strap to cable shielding tape

7 Seal the grounding-strap connection against possible entrance of moisture using rubber tape. Then cover entire joint with ⅛-in. thickness of rubber tape



8 Protect complete joint by covering with two layers of friction tape, painting each layer with waterproof insulating fluid. Same techniques used for T joints



9 Connect grounding strap to a solid ground since an ungrounded shield is mighty dangerous. Consider using a joint box for added protection in direct-burial jobs

In ungrounded systems add 1 in. to each. All underlying tape, Fig. 4, must be removed. If left on, it will fault from conductor to shield. When reinsulating, Fig. 5, insulate joint to diameter of connector plus; ½ in., 5 kv; ⅝ in., 8 kv; 1 in., 12 kv; 1¼ in., 15 kv. For grounded systems add ¼ in. Man doing the job should taper gradually at either end of joint, but do not tape over shielding tape.

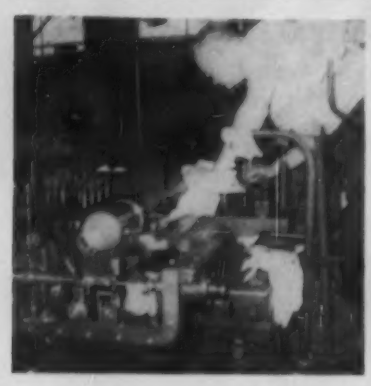
Shield joint operation, Fig. 6, is fussy. First off, use only all-copper-mesh tape. Cut in two equal lengths. Wrap tape from center to each end; overlap at center. Spot solder to cable shielding tape at each end. Run bead of solder entire splice length. Make sure splicer solders ground strap to cable shielding tape. Cover shielded joint tight with half-lapped friction tape.

After sealing, Fig. 7, protect entire joint with two layers of friction tape, Fig. 8. When joint is complete it should have an approximate over-all length of: 18 in., 5 kv; 20 in., 8 kv; 22 in., 12 kv; 24 in., 15 kv. For ungrounded systems add 2 in. Use same techniques in making tee, wye, X, 3-conductor joints.

This type cable is fast finding its place in industrial plants. Other types, however, are seeing wide service.

Photos and splicing data by Anaconda Wire & Cable Co, Hastings-on-Hudson, N. Y. For an easy-to-read splicing manual on this type cable for your plant electricians, write Anaconda asking for booklet DM 5566.

Latest PRACTICAL IDEAS *to help you keep*



Our turbine failed, but these improvements should prevent trouble

Our No. 2 5000-kw turbine-generator tripped out when oil pressure dropped suddenly. Trouble was with an expansion joint on the high-pressure oil line. Large leak caused failure. Then hot 110-F oil, squirting through the leak, atomized. Oil, spraying a hot steam line, caught fire.

We fought the fire with hand fire extinguishers for about a half hour. When we finally put it out, damages were costly. Two large electric motors under the turbine were completely ruined. Several electric controls were also lost. All the wiring around the turbine was burned out. Turbine springs were ruined as heat caused them to lose their temper. Governor was also ruined and had to be sent to manufacturer for rebuilding.

Auxiliary oil pump started to run as soon as the oil pressure dropped. Trouble was we couldn't stop it because the shutoff valve is under the turbine. That's where burning oil was falling. Since all our lube oil was spraying out through the leak, our auxiliary pump's turbine was soon running under no load. That caused turbine to reach a dangerous speed. Fortunately, only damage done from overspeed was our bearings scored. Also, our auxiliary oil pump and turbine froze. So you can see our equipment was very badly damaged.

Turbine manufacturer's service man supervised the overhaul. Turbine's top half and rotor were taken out. Governor and governing mechanism were dismantled. Both oil pumps were taken out. We found the main turbine bearings were OK, needed only a little scraping. Also, turbine's important working parts were in good shape.

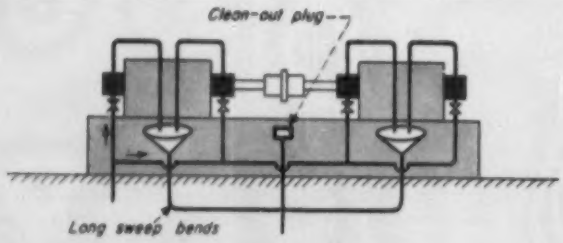
We replaced expansion joints with loop connections, center photo. High-pressure packing gland was worn, so we replaced it. Then we put in a new steam-end shaft slinger to prevent steam leakage from h-p gland. This leakage had been giving trouble for some time. Besides new slinger, we changed piping hookup.

We connected water line of gland condenser to condensate pump's discharge. This enabled us to increase water pressure to required 35 psi which, in turn, gave us the needed 2-in. vacuum at the gland condenser suction. For some time, we could get only about ½-in. vacuum.

We checked alignment of turbine bearings, also shaft clearances with a mandrel, photo. H-p end bearing was found to be too low, so we raised it 0.010 in. with shims.

When at last turbine was started, final adjustments were made and the unit placed on line. Improvements proved very successful. This turbine has run smoothly for over a year.

J A Troitino — *Bauta, Cuba*



My idea on good bearing-piping hookup

Piping cooling water to bearings in series is dangerous although many plants do it. One lost bearing causes a chain reaction. Then losses exceed additional cost of piping needed to hook up bearings individually.

Based on years of experience, my sketch shows a good hookup. Here are the advantages: (1) You can see each bearing drain from operating position of control valve. (2) Oval funnels in low position reduce splash and take little space. (3) Sweep bends in drains and clean-out plug above overflow point of funnels encourage keeping drains free.

(4) The wasted space is eliminated and there's no piping obstruction at end of foundation. (5) Saves 12 bends and several feet of piping over series hookup.

H S Tramberger — *Charleston, S. C.*

production going at top speed

STEVE ELONKA, *Associate Editor*

14 steam-line insulation tips

These tips will help you save Btu's:
1. Loose pipe insulation ups loss, is easily damaged by impact. Prevent by fitting insulation snugly around pipe.
2. Eliminate or reduce vibration in insulated pipelines to minimum. It causes joints to open, cuts down insulation efficiency.
3. Loose insulation may be from canvas jacket's failure. Carefully rewire insulation in place. Seal joints with asbestos cement. Replace canvas, paint.
4. Examine weatherproof lines regularly for cracks or openings. Wet lines reduce insulation values, cause piping, adjoining equipment to deteriorate.
5. Protect all insulation exposed to elements or wetting. Use weather-proof jacket.
6. After repairing insulation, replace as carefully as if new. Poorly applied insulation may fail, can't do good job.
7. Install acid-resisting jacket to lines exposed to alkali or strong acid fumes. Such fumes destroy holding wires, bands and canvas, allowing insulation to drop from lines. If acids are strong enough, piping or equipment may be attacked when insulation drops off.
8. Joints of high-temperature piping should be in double layer and be staggered to prevent excessive Btu loss, and damage to single-layer jackets when pipes expand with temperature.
9. Serious water hammer in steam lines may be from poor insulation. If so, after hammer has stopped, examine insulation for damage. Water-hammer impact often opens joints. Then insulation needs resealing with asbestos cement.
10. Stop leaks in hot-water or steam lines as soon as possible. Either one may cause insulation to fail rapidly.
11. Loading of insulated pipe, as by stepping on insulation, dragging ladders over insulation, can cause serious damage. Insulation may look OK and yet be distorted. Thus, its structure is ruined, reducing insulating qualities.
12. Don't use insulating cement in place of block or pipe insulation. Not as effective. Use only on irregular surfaces.
13. Insulating flat surfaces also applies to No. 12 above. Where ventilating ducts go through buildings, insulation reduces ventilating noises.
14. Some people pulverize broken pieces of 85% magnesia or blocks, mix with water and use as a patching cement. This cement won't be as efficient as new.

B A CROSSON *Cranston, R. I.*

Don't let this oversight happen to you

NEW 125-psi 30,000-lb-per-hr boiler of same capacity as older unit was installed in a chemical plant. Because condensate and steam were contaminated in some plant areas, blowing down solids was an important part of plant operation. Even so, new boiler was piped into old blowdown tank, because these blowdown periods could be staggered.

After new boiler was tested hydrostatically, blowdown and drain valves were opened to empty it into blowdown tank. But water level didn't drop in steam drum. Valves were inspected and found OK—but still water wouldn't flow to tank.

After much cussing, someone suggested checking piping to blowdown tank. To everyone's surprise, new piping had been welded to old without cutting an opening into the old header. Don't let this happen to you.

H B WAYNE *Brooklyn, N. Y.*

Now! Here are friction data on porcelain

TO SELECT a pipe or sheet-metal shape of proper material for a certain use, you must consult many reference books. You may have to write firms manufacturing special alloys and coatings. These friction data will help you decide if porcelain-enamel coatings are the answer. Data apply to both widely used pipe and formed sheet-metal shapes.

Here are three main friction qualities: (1) Friction factor of metal pipes compared to friction factor in porcelain-enameled pipes when both are new. (2) Rate of friction-factor increase in metal and porcelain-enameled pipes over long periods of time. (3) Rate of friction-factor increase related to increase in velocity of material being passed through coated and uncoated pipe.

Velocity, ft/sec	*Friction factor of pipe*	
	Enameled	*Cast-iron*
8	0.0150	0.020
20	0.0125	0.019
40	0.0110	0.018
200	0.0085	0.018

Problem of friction focuses about turbulent flow rather than laminar flow. Turbulent type is where flow of liquid, gas or solid substances through pipe varies in amount or where pipe isn't completely full of material being sent through it. Flow is laminar where pipe is completely full of material being passed through it. There's no friction factor in laminar flow as a lubricating coat is formed on pipe wall that eliminates friction on almost all the moving liquid. Here there's 100% friction condition at pipe wall itself.

Compare new pipes, one of cast iron and the other porcelain enameled, and you find there's lower friction in enameled pipe. In 5-in. pipe at velocity of four feet per second, enameled tube had friction factor of 0.017 compared to 0.022 in cast-iron pipe. Improvement is 2.26% for enameled pipe. Difference changes rapidly as velocity increases. See table, at left, for answers.

W W CARPENTER *Cincinnati, Ohio*

(Continued on page 130)

More PRACTICAL IDEAS

Begins on page 128

Our floating poles stop debris nuisance

Trash, such as leaves, tree limbs, cans, float down the Mississippi past our circulating-pump inlet. Our trash rack catches heavier objects and a traveling screen stops the rest of river debris. In winter we are troubled by floating ice piling up in front of trash screen.

To prevent floating objects piling up at trash screen, I installed poles as pictured in attached photo. There are three 40-ft poles fastened together, cabled so they rise and fall with river changes. Poles are set so they catch floating objects. Current gradually works them out to end of down-stream pole where debris floats down river.

These poles save us lots of trouble, especially during and after heavy rain storms when floating debris increases. They are also helpful for leaves and floating ice in winter months.

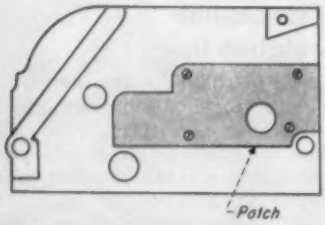
Pole downstream is set to prevent floating object from re-entering screen when washing debris out of traveling screen.

Condenser fouling and screen washing is now reduced. These poles have been in use about three years with excellent results, saving us headaches.

C J WERDERITCH *Clinton, Iowa*

Wire-thread inserts toughen aluminum threads

One diesel maker uses 232 stainless-steel thread inserts in aluminum casting. Aluminum casting threads tended to strip and wear before using inserts. First photo shows how hole is tapped oversize to receive insert. Second photo shows insert wound into threads with special tool to receive steel machine screws. Inserts are made by Heli-Coil Corporation at Danbury, Conn.



Stainless steel solves stoker problem

SKETCH SHOWS side block or cheek of watercooled spreader-type stoker. Abrasive action of coal particles eroded the operating sides (inside) of our side blocks. We renewed them with stainless steel.

Practice now is to operate side blocks until erosion thins down the watercooled surfaces. Then side blocks are removed and surface is machined deep enough to make patch a flush fit. Countersunk screws hold the patch plate to this block.

Coal-unloading steel hopper under the railroad siding also corroded, as well as the conveyor sides and bottom plate. A year ago, bottom of hopper was replaced with stainless steel as were the conveyor sides and bottom. Since installing the stainless steel, there's almost no thinning of sheets. We'll also replace corroded sheets of stoker-feed ducts from the overhead bunkers with stainless steel in the near future. We'll save money in the long run and have troublefree operation.

J M GORRIE *Euclid, Ohio*

Wood cleans threads

TAPPED HOLES can be cleaned out by running soft pine wood into hole. Particles loosened from threads imbed in wood. Threads are perfectly clean, making it easy to screw in bolt. Just take a round pine stick, with approximate diameter of bolt, and screw into threads.

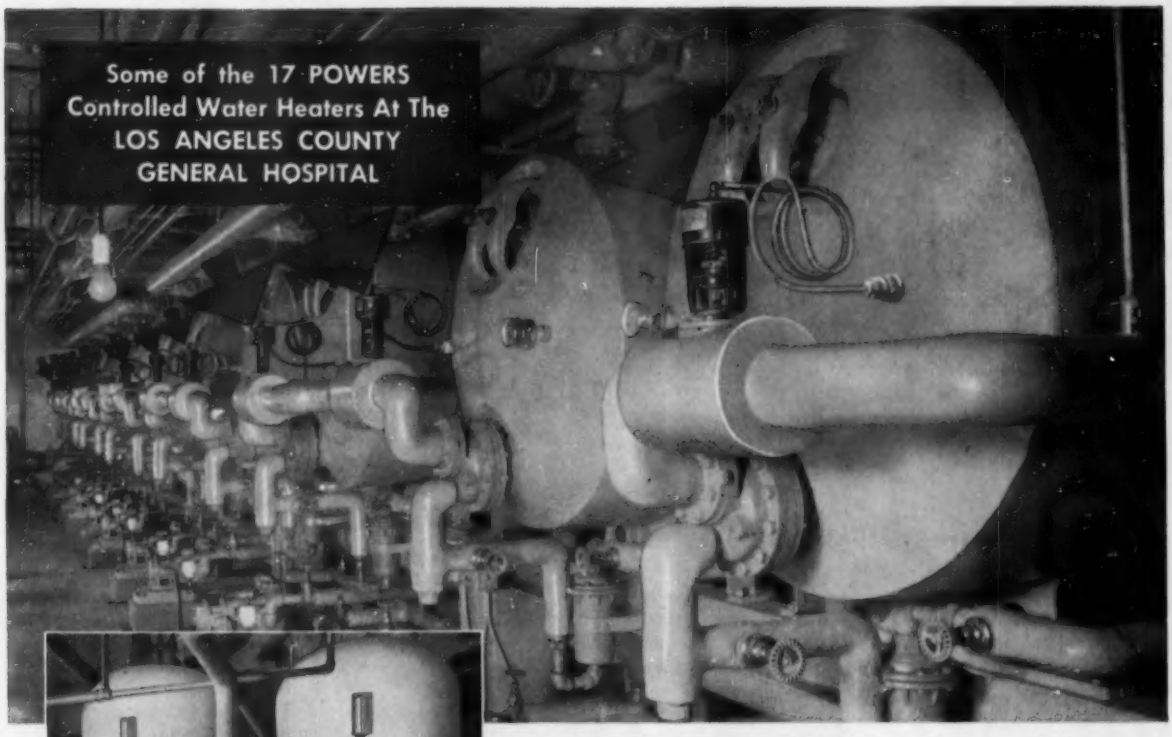
W E WARNER
Woodford Green, Eng.

Any ideas?

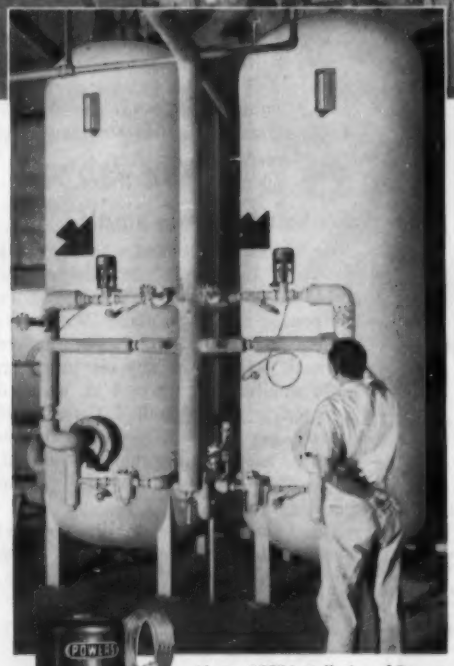
NOW, WOMEN WORK in our shops. We have to safeguard their delicate skin by placing guards over hot mercury-lamp tubes. We need something made on close dimensions because of the space limitations involved. Yet guards themselves should not run sufficiently hot to burn operators. Any ideas, readers? We need help to lick problem.

P C ZIEMKE *Oak Ridge, Tenn.*

(*Continued on page* 132)



In 1933 Howe Bros., Contractors, installed 15 Powers Regulators here. All are still in operation, only 11 are shown in photo above.



Above: 1955 installation of Powers Controlled Water Heaters in Contagious Disease building. Contractor: E. Willardson Company.

"after 22 Years *of good service*

POWERS No. 11 Self-Operating TEMPERATURE REGULATORS

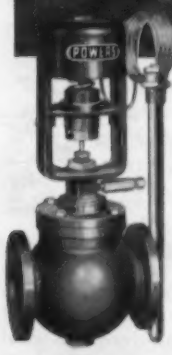
are still giving dependable control"

Reports Mr. Louis J. Koch, Senior Master Mechanic

Performance records like this are not unusual with Powers regulators. With today's high cost of maintenance Powers time proven QUALITY controls are a more profitable investment than ever before.

More POWER$ to You — when you want thermostatic control for water heaters, heat exchangers, heating and air conditioning systems or processes.

Automatic control pays big dividends . . . *IF* you have the right type of control and proper size valves for your requirements. Make sure, call POWERS nearest office for help with your problems.



(c48)

POWERS No. 11 Self-Operating TEMPERATURE REGULATORS
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POWERS CONTROL

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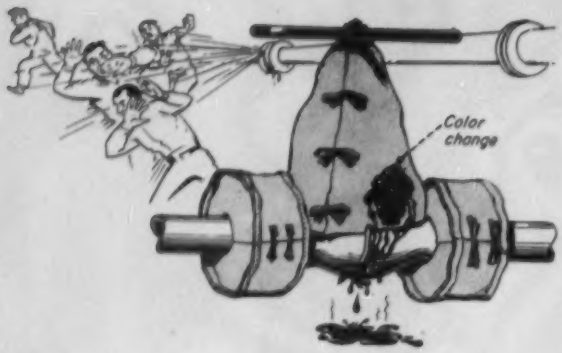
SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

Over 60 years of Automatic Temperature and Humidity Control

More PRACTICAL IDEAS

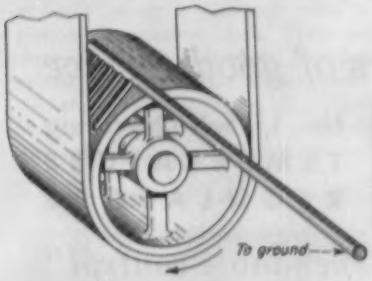
Begins on page 128



Acid leaks are spotlighted the instant they happen

Covers for flanges and valves shown flash a brilliant color change the instant leaking chemicals hit them. Color changes even if leakage is a mist so fine it's invisible.

Covers for caustic lines are white; they change to purple. Red covers are used for acid lines; they change to yellow. They not only help find a leak the minute it starts, but covers prevent dangerous sprays harming personnel. *Courtesy, Milsheff Corp, Darien, Conn.*



Metal comb licks belt static

Static electricity built up on some of our machines until shock to operators was annoying, also dangerous. We knew static was generated in belt drive so tried various remedies. Wires were grounded on shaft and to grounded chains dangling on belts. They helped slightly. We finally tried method shown, which licked our problem.

Here we use a comb of round one-inch brass bar, fitted with quarter-inch brass pins. Pins are spaced one-eighth in. apart. Comb is attached to machine so pins are as close as possible, without touching belt and pulley at point where belt leaves pulley on offcoming side. We then made a good ground connection with comb.

No arcing is now observed in operation. Comb carries off static before it can build up enough to throw an arc.

L KASPER *Philadelphia, Pa.*

Thumbscrew solves setscrew problem

Brass adjustable metering disk in our solenoid fuel-oil valves is adjusted with a ⅜-in. Allen head wrench, inserted into the disk socket. The setscrew becomes enlarged through normal use and the wrench slips in the socket. We drilled and tapped the socket, inserted a thumbscrew and lock nut. Now we have better control. Thumbscrew and lock nut have many uses.

E ZELLIEN *Bronx, N. Y.*

Old flashlight makes trouble-shooter

Discarded metal flashlight-casing, with a piece of welding rod brazed to its bottom end, makes a fine sounding device. Use to detect faint noise in bearings, gears, engines, etc.

B K PROBERT *Rialto, Calif.*

Make refrigerator explosionproof

WE HAD a few bad explosions in an ordinary domestic refrigerator used for storing open receptacles of volatiles in our research laboratories. That's when we decided to be practical and give our physicists a unit that could store volatiles safely. Freezer compartment's magnetic switch was moved to the motor compartment. There fumes are no safety hazard. We removed connection to door switch that operated the light. No more trouble from sparks. Also ended was hazard of lamp breaking when refrigerator contents bumped it.

When completed, we made a legible sign of sheet metal with black lettering and a yellow background as follows:

CAUTION

Don't store open containers of flammable liquids with flash points greater than 187 F in this refrigerator. This is not a storage vault for spare stock. Limit to those quantities in actual use for refrigeration necessary.

P C ZIEMKE *Oak Ridge, Tenn.*

Make mandrels *small*

I'VE POURED babbitt for many shaft journals. In the average machine and up to 6-in. journals on air compressors, we poured babbitt in place. We always heated frame and journal. We removed journal, scraped it, cut oil grooving.

In smaller stuff up to 4 in. we used mandrels (when we had time, or to satisfy somebody's whim). Mandrels must be made smaller than the journal, so babbitt takes up shrinkage when cooling.

You must have a smaller mandrel because the metal shrinks away from it. Then you have metal left for scraping to shaft size and clearance.

J M GORRIE *Euclid, Ohio*

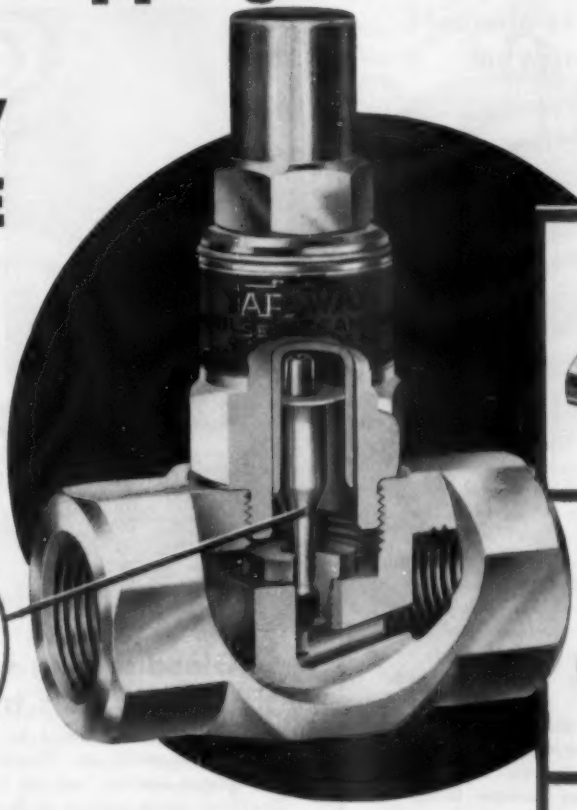
Can't electricians write?

FEW OF YOU ELECTRICIANS send me practical ideas. What's wrong? Can't you guys write? Or do you have too much money? Every time I visit a plant I run into all kinds of clever electrical hookups. But getting you fellows to send them in—so I can pay you—is like pulling teeth. How come?

—*Steve Elonka*

the impulse that revolutionized steam trapping

YARWAY IMPULSE STEAM TRAP



the only moving part

...a small stainless steel valve that literally floats on the condensate load. Gets equipment *hot in a hurry*—and *keeps it hot!*

SERIES 60 and 120

For all *normal* trap requirements, pressures to 400 and 600 psi.

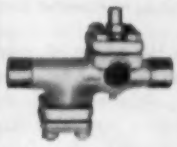
½" No. 20-A

For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40

For *heavy loads* requiring extra high capacity steam traps.

INTEGRAL-STRAINER HIGH PRESSURE TRAP



For *high pressures, high temperatures.* (Flanged or welding connections.)

Twenty years ago YARWAY applied a unique theory of thermodynamics to steam traps—and gave industry the amazing YARWAY Impulse Steam Trap.

Today — over a million YARWAY Impulse Steam Traps later — advantages like the following continue to convert new users, and convince old users to standardize on the YARWAY Impulse:

- **QUICK HEAT-UP AND EVEN TEMPERATURES OF EQUIPMENT**
- **GOOD FOR ALL PRESSURES WITHOUT CHANGE OF VALVE OR SEAT**
- **SMALL SIZE—LIGHT WEIGHT**
- **ONLY ONE MOVING PART**
- **STAINLESS STEEL—minimum maintenance**
- **WON'T FREEZE UP**
- **A COMPLETE LINE of sizes and types for every requirement**
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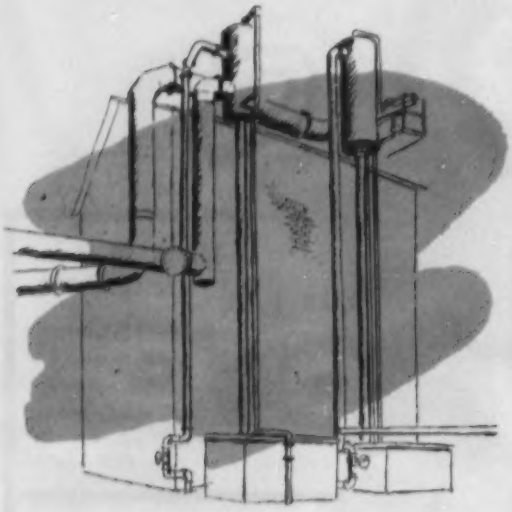
Solving PLANT PROBLEMS... readers



The question

What's wrong with condensate removal?

THE FACTS: We operate a 750-kw turbine generator in our plant, with the turbine exhausting to a barometric condenser. Inlet steam is 150 psig and condenser vacuum is 27-in. Hg.

Condensate removal, from barometric condenser, is handled with a vacuum trap that includes a water spray to prevent condensate flashing due to heat from auxiliary steam entering the condenser.

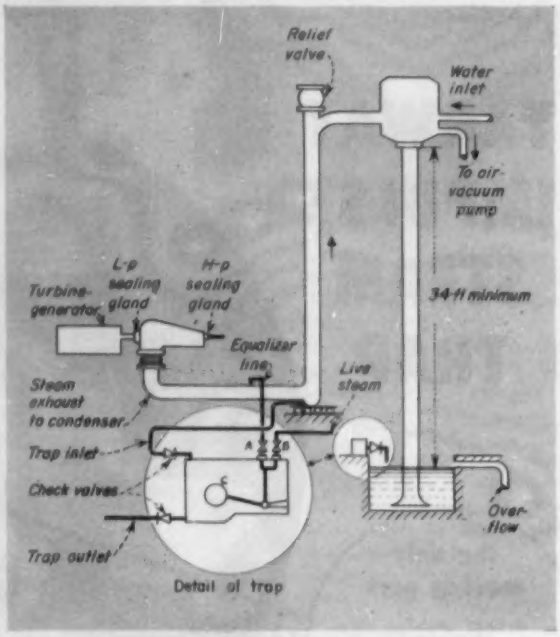
Under full-load conditions and normal steam pressure the trap discharges condensate once every three minutes. Water never appears in the condenser sight glass.

But when turbine is operating at less than 300 kw or at full load with inlet steam at 110 psig or less, the vacuum trap will not operate. When this happens we have to operate the turbine noncondensing, to remove water from the condenser.

I'd appreciate the views of readers on this problem, and how it might be corrected.

—WHC, August Power

The answers



Gland-sealing stem may be WHC's trouble

I don't believe *WHC* should be piping auxiliary steam to the barometric condenser. This steam could be used to better advantage heating feed, or even blown to atmosphere.

The flash steam he sees is from steam that operates the vacuum trap—not from the condensate. At 27-in.-Hg vacuum, steam temperature is about 115 F—too low to flash.

Trouble may well be due to poor sealing glands on both the high- and low-pressure sides. Sealing steam is usually supplied from first turbine stage. An additional source of steam would help solve the problem.

My experience: We had two turbines with barometric condensers. One worked fine. The other needed a vacuum trap. Unit with the vacuum trap didn't have enough elevation on the barometric condenser. And during light-load periods, water would rise in the condenser tail pipe and pass into the turbine exhaust. To get sufficient fall to the trap it was installed on a platform in the condenser hotwell, drawing above.

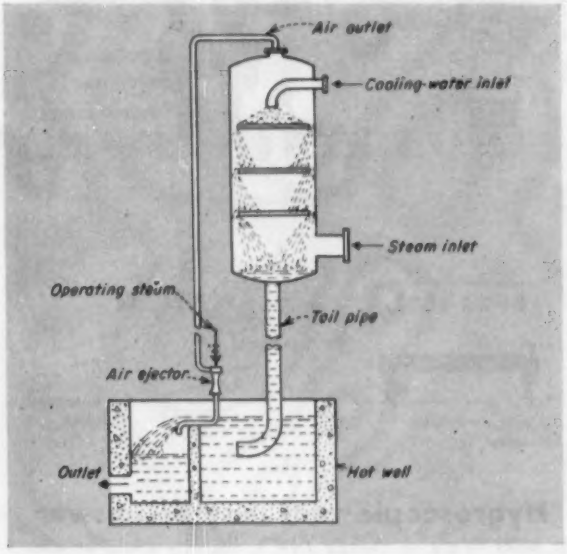
Vacuum trap works like this: Inlet and outlet are fitted with check valves. Equalizer line from top of trap is controlled by valve *A*. Live steam enters trap through valve *B*. When trap is at rest, float arm opens valve *A*. As water rises in the trap, float *C* closes valve *A*, opens valve *B*. Steam pressure closes the inlet check valve. Water in trap is blown through outlet. When trap is empty, valve *B* closes and valve *A* opens. Also, outlet check valve closes, inlet opens. Flashing may come from steam used to blow water out of trap.

Make sure there are no air leaks in the system—especially on the equalizing line. And sealing water should be well over bottom of the condenser tail pipe.

G G Avant *Wilmington, North Carolina*

cure each other's headaches

HOWARD KALLEN, *Assistant Editor*



Vacuum-trap size is too small for part-load steam conditions

At 300 kw, turbine is operating at 40% of the design rating. With the same cooling-water temperature and flow rate to the condenser, a higher vacuum is available.

A vacuum trap is designed to operate within a relatively narrow range of vacuum. Chances are the higher vacuum, which *WHC* gets at loads of 300 kw and lower, is greater than he needs for efficient operation. Result is poor drainage.

When throttle steam drops below the 150-psig design figure, turbine water rate goes up, calling for more steam, passing a greater flow to the condenser. If this is happening, the trap size will be too small. It won't drain water fast enough to keep level from rising. For instance, if the turbine efficiency is 70% at full load, using 150-psig throttle steam and exhausting at 27-in. vacuum, the estimated water rate is 16 lb per kwhr, or 12,000-lb-per-hr throttle flow to the turbine and condenser. With 110-psig throttle steam, at full-load operation, steam flow increases since there's less available energy per pound of steam. Result: Turbine internal losses climb, turbine efficiency dips. If turbine efficiency drops to 65%, the estimated water rate is 18.5 lb per kwhr, or 13,875-lb-per-hr steam. Although these figures are approximate, they show the turbine performance trend—and its effect on condenser performance. Steam flow increases by almost 2000 lb per hr.

Sketch above shows a typical barometric-condenser arrangement.

I would suggest that *WHC* measure the throttle-steam, condenser-water and auxiliary-steam flow rates when he operates at part load. If comparison of flow rates with the vacuum-trap rating shows that trap is too small, he can install a larger trap or two traps in parallel. One trap operates when turbine is running at design conditions. When operating at other conditions, *WHC* can use both traps.

H B WAYNE — *Brooklyn, N. Y.*

Steam-inlet valve to trap may need repair

Normally a barometric condenser needs no auxiliary method of condensate removal under vacuum. Removal from the hotwell, under atmospheric pressure, shouldn't require a trap. *WHC's* condenser sounds more like the jet type.

Light load. Chances are the steam valve inside the trap is defective. It's probably leaking steam into the trap during the valve shutoff period. Below 300 kw, not enough condensate enters the trap to keep backpressure from being maintained. Naturally, the backpressure tends to relieve itself through the equalizing line. But the line's capacity is limited. As the backpressure builds up, more condensate flashes, less condensate enters. Conditions soon reach a point where trap-pressure build-up prevents condenser drainage into the trap. And the trap can't operate without a full charge of water. New seat on the steam-inlet valve on the trap overcomes this trouble.

Full load. When the turbine operates at reduced throttle pressure, its water rate increases, exhaust steam becomes slightly drier. For this machine, resulting condenser overload is about 12 to 15% over full-load conditions. Cooling-water flow stays constant since it depends on the system vacuum and system layout. Condensate temperature approaches the saturation temperature corresponding to the turbine exhaust pressure. When condensate enters the trap and meets steam leaking in through defective steam inlet valve, part of condensate flashes (as in light-load operation). Result: Flash steam plus leaking steam tends to build up trap backpressure, stopping condensate flow from condenser to trap. And repairing the steam-inlet valve to the trap will also overcome this trouble.

J SCHNEIDER — *Needham, Mass.*

Is tail pipe long enough?

Some water level should be maintained in the tail pipe to insure no air backflow through the trap and through check valves that might be leaking.

Vacuum trap trouble can be due to: (1) Condensing-water pump pressure may be too low. (2) Air ejector may not be pulling because of poor action of jets. (3) Air leakage into condenser may be excessive, causing trap to become airbound. (4) Too-high pressure differential across the trap keeps it from opening.

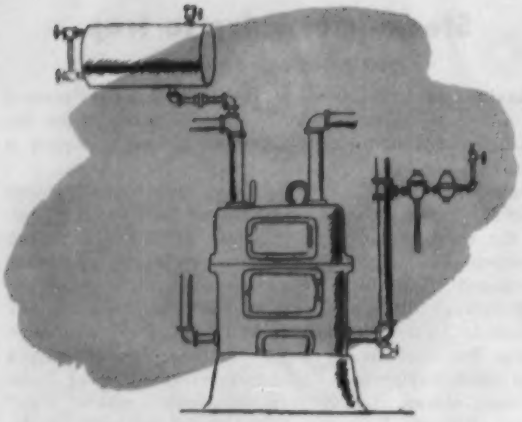
Possible cures for the above are: (1) Remove vacuum trap and increase tail-pipe length so condensate level can build up to 35 to 40 feet, discharging to a hotwell. Condensate level in hotwell should, of course, be above tail pipe. Hotwell then overflows because of height of water in the tail pipe. (2) Install a pump under the existing tail pipe, controlled by a level float in the condenser. (3) Install an equalizing line between the trap and a dry point on the condenser shell. Condensate then flows to the trap by gravity.

A J BREUGELMANS — *New York, N. Y.*

EDITOR'S NOTE: Turn page for readers' solutions of *JAW's* hot-water heating problem. Then, for additional discussion on radiator air binding, see article, p 122.

More PLANT PROBLEMS

Begins on page 134



The question

Why does radiator become airbound?

THE FACTS: We have a small single-loop-header forced-circulation hot-water heating system, with eleven radiators tied to the loop. A hot-water expansion tank is mounted near boiler room's ceiling with a single pipe connecting it to hot-water discharge line from boiler to radiator-loop header.

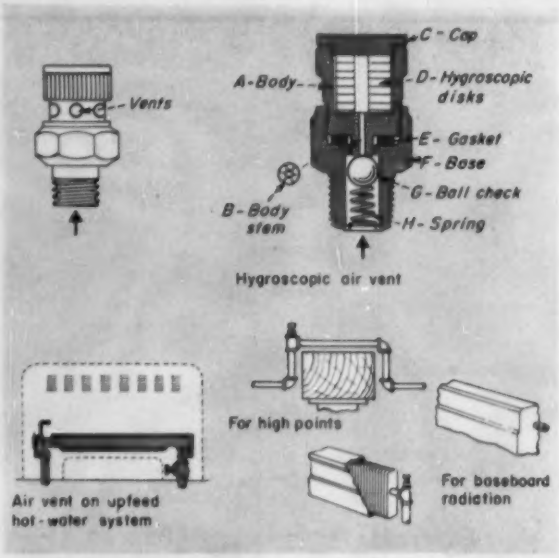
First radiator on the loop is continually becoming airbound. It's the only radiator that ever gets air in it. And to keep the radiator usable I must bleed air weekly. As a result, the expansion tank becomes flooded every year and it's a nuisance to drain and recharge it to the right level.

I've had several explanations of what's wrong but none seem to get at the root of the problem. It's been suggested that I relocate the expansion tank to the same level location, directly on the boiler. Others say this is no good.

Do readers have any ideas on how I can cure this problem?—*JAW, August Power*

The answers

Editor's note: For additional discussion on radiator air binding, see article, page 122



Hygroscopic vent may be answer

It looks to me as though *JAW's* difficulty could be eliminated with the hygroscopic air vent shown above. This unit automatically vents air whenever it accumulates, but closes when water enters the automatic vent.

Automatic operation. Screw the body *A* tightly into base *F*. Bottom of stem *B* is grooved. These grooves allow air or water to pass around top of ball *G*, into the center hole of stem *B*, and then into contact with disks *D*.

On contact with air, the hygroscopic fiber disks shrink, and the air automatically vents through the spaces between the disks and out the body vents.

On contact with water, the hygroscopic disks expand, automatically preventing water flow through the body vents.

Manual operation. Decrease pressure on gasket *E*, allowing air to escape past the gasket and up through threads of base *F*. When water starts to flow, tighten body.

Manual venting should be used each time the heating system is put in operation, to get rid of accumulated air.

R W CUMMING *Sarco Co, Inc, New York, N. Y.*

Keep air in expansion tank

JAW's difficulty is caused by two natural effects: (1) Air dissolves more readily in cold than in hot water. (2) Water expands when heated.

Second effect causes substantial water flow between the expansion tank and rest of the system as heating goes on and off. Water in tank is always cool and, in contact with air, absorbs quite a bit of air. When water from tank is heated in the boiler, this air is driven off to be trapped in the first radiator.

JAW should take advantage of these natural effects. If he alters piping so air driven off can only go to the expansion tank, he will never have to bleed radiators or recharge his expansion tank—if his system is tight. Also, the system is quieter since this hookup gradually removes air from the radiators—a common cause of noise.

T H MONROE *Newburgh, N. Y.*

(*Continued on page* 138)

DOUBLE-BARRELED PROTECTION

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More PLANT PROBLEMS

Begins on page 134

Is system hooked up right?

JAW doesn't say whether radiators are above or below the main. If radiators are all below the main, then line to the radiator should tie into the top connection and out the bottom. Main should be pitched to the high point from the boiler. Automatic air vent at this point bleeds air from the main.

If he has radiators both above and below the main, then line to the radiator should tie into bottom connections at each radiator end. Also, he should vent each radiator.

It may be that *JAW's* first radiator is above the main, with inlet connection at top and outlet at bottom. This is OK for a steam radiator, but not for hot water. With hot-water heating this setup restricts water supply when air collects at the inlet point.

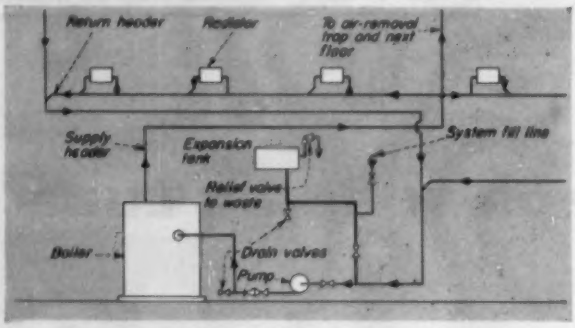
If the system has been operating for some time there may be a small leak that allows air to be drawn into the system when circulation stops, and piping, radiators begin to cool off.

S R Higgins — *Long Beach, Calif.*

Reduce expansion-tank elevation

I have a system identical to *JAW's*. He should lower his expansion tank so middle of tank is same height as discharge header. Also take feeder line, to expansion tank, off discharge loop and connect it to the return line—close to the heating boiler. In this way no air can get into the system after the lines and radiators are purged.

F W McDevitt — *Sacramento, Calif.*



Hook the expansion tank to pump site

Disconnect expansion tank from hot-water supply line near boiler and hook it to water circulator's inlet side, sketch shown above.

Connecting the tank this way still protects against surges, but no air can be forced into the water stream. Also, a more uniform pressure exists at the circulating pump's suction.

Automatic air trap at the top of riser, in the loop heating system, will remove entrained air as the air separates from the hot water in the riser.

A J Breugelmans — *New York, N. Y.*

YOUR NOVEMBER PROBLEMS

1 What's best way to burn residual fuel in our diesel plant?

I'm superintendent of a municipal diesel plant that includes four diesels. Two are 1000-hp turbocharged machines running at 400 rpm. The other two are 500-hp noncharged engines that are running at 300 rpm.

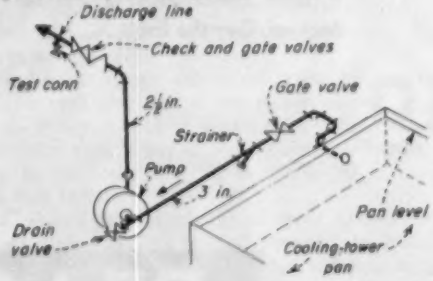
We're now burning a relatively high-cost distillate fuel. Naturally we're always looking for ways to trim our operating costs and we've been giving consideration to switching over to the burning of residual fuel. But not having previous experience with residual fuels, we're faced with a number of important problems:

What is a good hookup and what additional equipment do we need for burning No. 6 oil? Will extra maintenance wipe out our potential savings? Should we consider additives? Does blending with lighter oil pay? We'd appreciate getting opinions of *Power* readers on this matter—*AL*

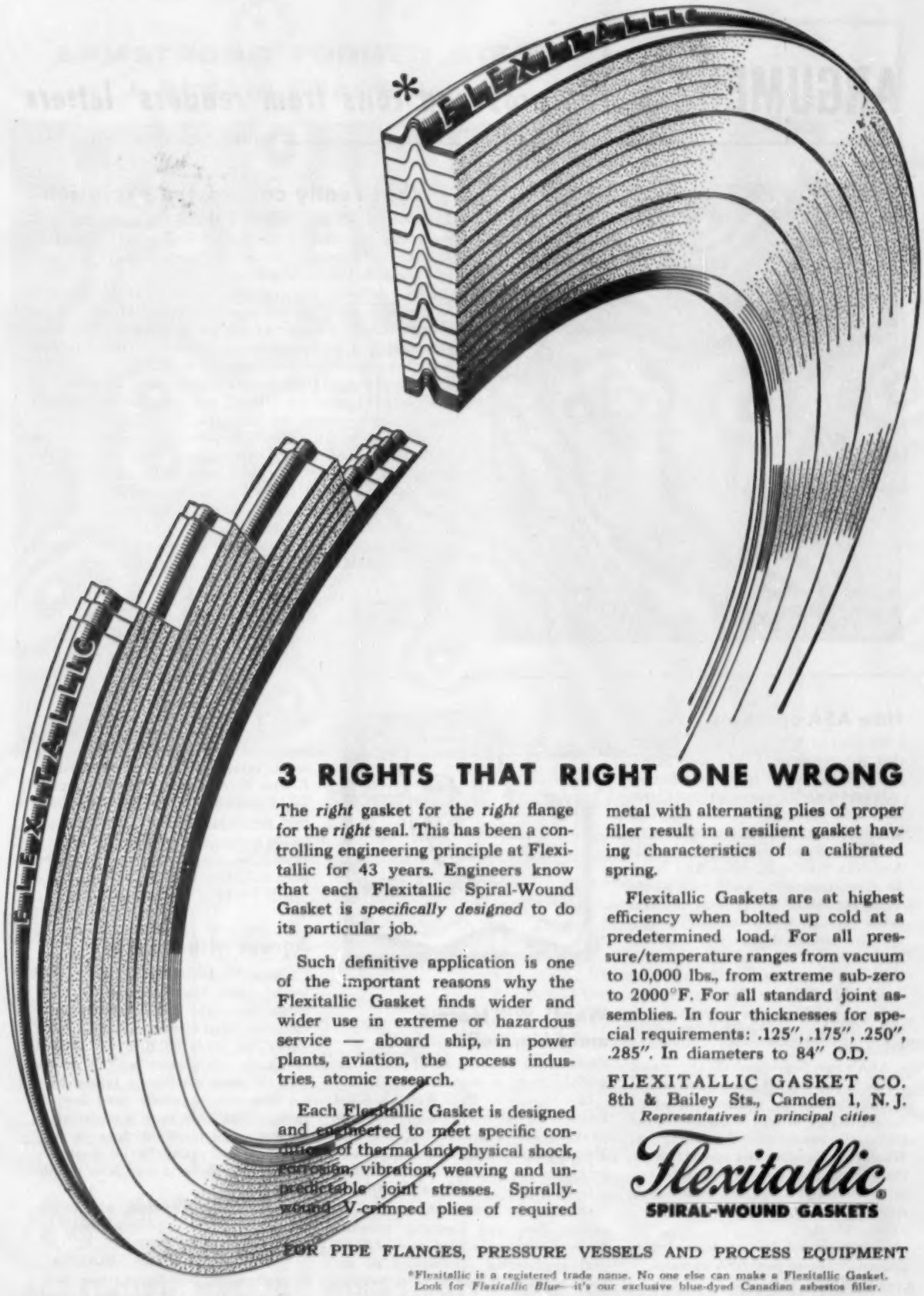
2 How can we quiet annoying cooling-tower vibration?

One of our cooling towers, drawing below, gives us trouble because of vibration noise near the circulating pump. In one of the offices along the line, noise is so intense, we can't live with it.

Pump and motor mounts are rubber cushioned, but noise persists. Can *Power* readers tell us how to quiet our system?—*JDC*



Sit down right now and answer one or both of these problems. We'll pay extra for answers with photos or sketches.



3 RIGHTS THAT RIGHT ONE WRONG

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ARGUMENTS . . . *pros and cons from readers' letters*

ALTHEA THORNTON, *Assistant Editor*

What really caused the explosion

I was very much interested in J M Gorrie's comments about the boiler explosion at the Euclid Senior High School (p 138, August POWER). Apparently certain things appeared to happen, but actually did not.

I have followed this explosion carefully, as the Board of Education retained me to recondition the plant and get the boiler restored to service as quickly as possible. This heating plant is a high-temperature hot-water system; it even heats the school's domestic hot water.

Gorrie states that the fireman had inserted an oil-soaked wand into the boiler for light-off, and the explosion occurred when he was opening the gas valve. But this is not true.

First, boilers are natural-gas power-draft fired, and the torch for light-off is a gas-flame instrument. Second, the boiler was under fire, had been burning for about 20 minutes, and had raised the water temperature about 30 degrees. When the explosion occurred it was apparently still in burning operation. Fireman states he had just observed the flame through observation-port window and had stepped to the boiler front to check on water-temperature reading when explosion occurred.

Boiler had been purged before light-off; flue damper was wide open and the draft-fan vortex damper was open. Unit

(*Continued on page* 194)

How ASA operates

I am glad to see, p 104, June POWER, that you recommend American Standard C-50 as helpful in motor selection.

From time to time we note that standards approved by the American Standards Association are referred to as "ASA Standards" rather than as American Standards. Since ASA is not an association in the usual sense of the word, but rather the national clearing-house through which voluntary standards are developed, we try to lean over backwards to disassociate ourselves from any proprietary claim to these standards. We serve as the machinery through which groups concerned can come together and develop American Standards.

ASA's role is procedural. Our major job is to see that all groups that would be affected by a proposed standard have a chance at representation on the technical committee developing it. When the committee has agreed, we see that the standard obtains a consensus of all concerned. When that is achieved, ASA approves the project as an American Standard.

I hope this will give readers a better understanding of how ASA operates.

G F HUSSEY JR
American Standards Association

What! Will Marmy make him well?

Please rush two copies of *The Marmaduke Story* as soon as possible.

One copy is for Paul Weilnau, Chief Engineer of our Avery plant. He's hospitalized with a broken leg. I'm sure Marmy's vast experience and gusto will help pass the time and lessen tension.

R P DAVIS *Norwalk, Ohio*

MARMADUKE'S NOTE: BILGEWATER on passing time and lessening tension! Weilnau's getting a good dose of practical engineering information in my book, and that should do a lot to raise his anchor so he can sail in a hurry.

Don't need desuperheater

SOLUTION to the problem of holding steam pressure constant, submitted by Reader Wayne (June Plant Problems), could probably be simplified by omitting the desuperheater. Assuming the steam is dry, saturated at 600 psig, it should be almost dry and saturated after reduction to 300 psig.

R H FREYE *Muskegon, Mich.*

Agrees with Bogart

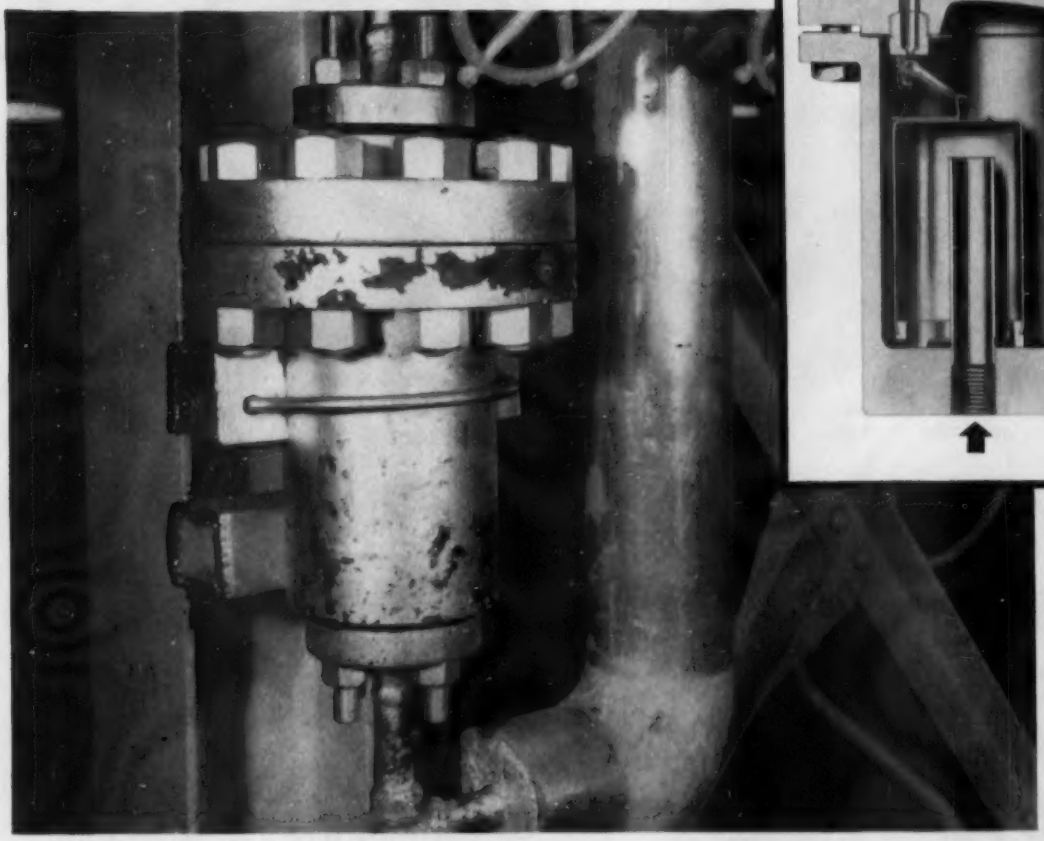
I agree wholeheartedly with Arnold Bogart (May Arguments) in his statements that traps will not meet manufacturers' rated claims. Our experience shows that traps installed for a given rating, in conjunction with a heater with the same condensate rating, have not been able to handle rated flow. It appears that when some manufacturers suggest sizing traps for three or four times normal rating, it is absolutely necessary to do so if trap is to handle desired flow.

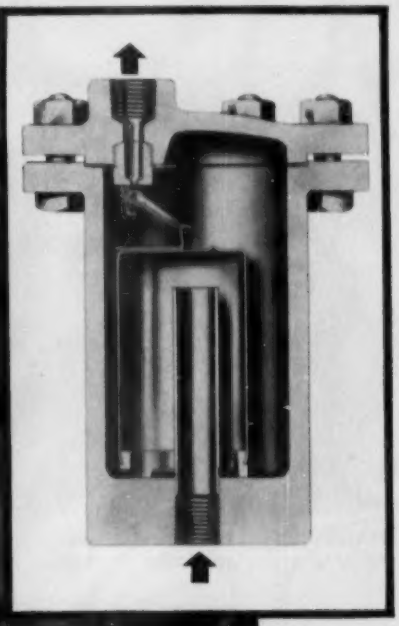
A standard test method, with industry-wide adoption, is badly needed.

M N COLLISON
Flin Flon, Manitoba

EDITOR'S NOTE: See leading trap makers' comments, p 120, October POWER.

ARMSTRONG FORGED STEEL STEAM TRAPS . . .





. . . the Best Answer to Superheated Steam Line Drainage, because:

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Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

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SEND FOR THIS LITERATURE:

1. **Should we trap superheated steam lines?**—the answers of 11 engineers who have used traps for this service.

2. **Catalog J**—complete data on forged steel traps and steam trapping.

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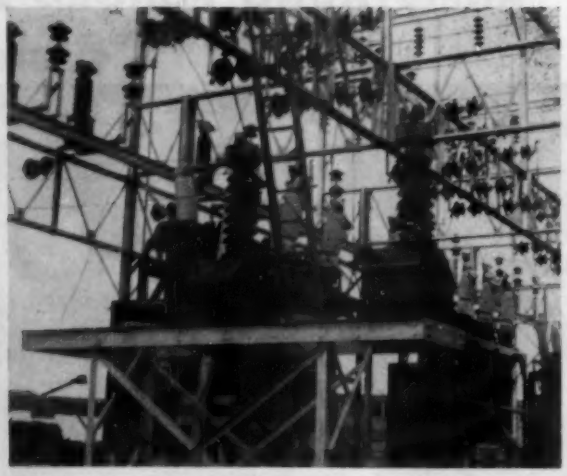
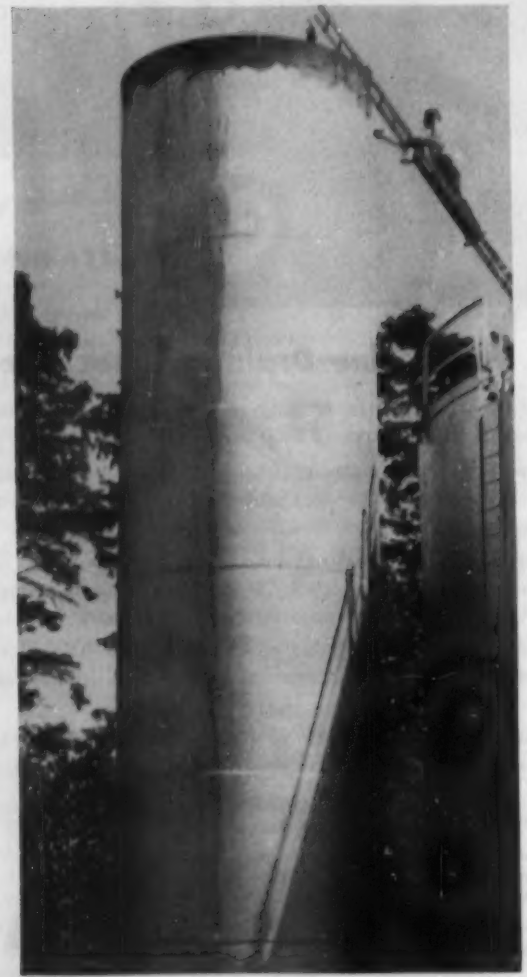


STRUCTURAL STEEL exposed to elements take a beating. New zinc coating gives mechanical and chemical protection here



ONE COAT applied on metal directly is tackfree within 40 min. It will be completely dry in about 48 hr

HOW TO

'cold-galvanize' with zinc

► New zinc-base coating, to brush or spray on iron and steel, is claimed to combine with base metal. Surfaces coated create an electrochemical union, thereby uniting the zinc with base metal's surface.

Basic difference, from that of other metallic paints containing zinc, is claimed that it actually combines with base metal. Thus it sets up electrical continuity, offering true cathodic protection. It leaves coating of 96 parts of chemically pure zinc, by weight.

If applied directly into adhering rust, it induces rusted area to create its own nonflaking coating. That stops further rust and prevents "rust creep." Big advantage claimed is this coating eliminates need of dismantling to galvanize surfaces with zinc. It is "cold-galvanized" direct to object, regardless of size. Single coating covers about 725 square feet per gallon.

Based on technical data in booklet, "Galvicon," Vol 452, Galvicon Corp, 40 West 29th St, New York, N. Y.

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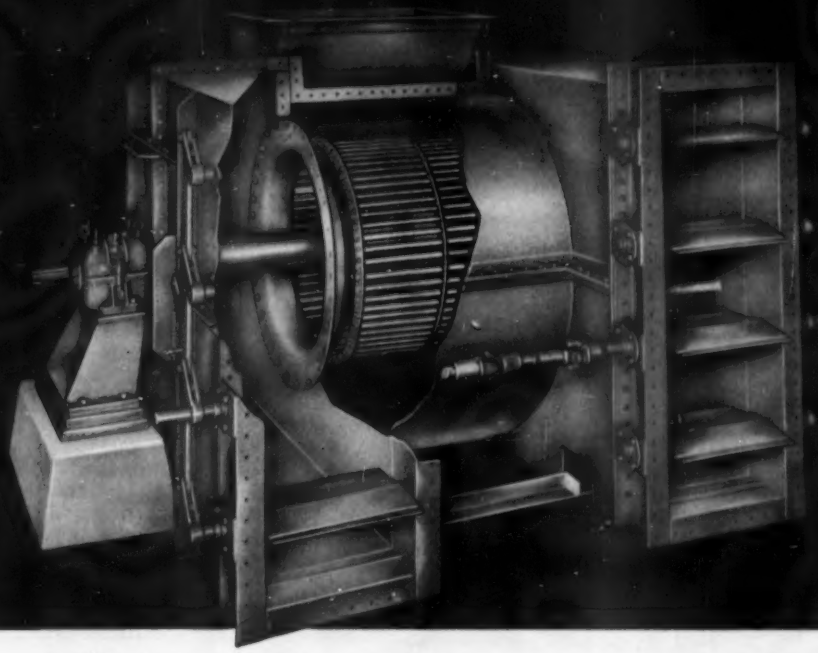

Inlet damper control saves horsepower at reduced loads by spinning entering gas in direction of wheel rotation.

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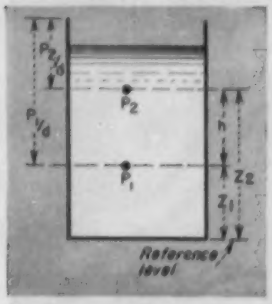
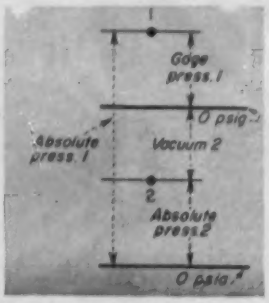
BASICS . . . bringing engineering theory down to earth

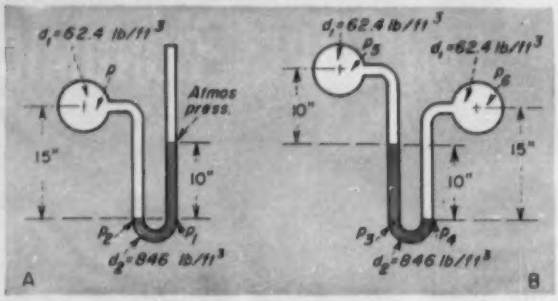
HOWARD KALLEN, Assistant Editor



1 Pressure diff between two points depends on height



2 Sketch shows how to measure gage, absolute press.



3 Manometers can be hooked up in variety of ways. *A* reads pipe pressure. *B* reads difference between pipe pressures

FLUID FACTS — 3:

How to figure static pressures

► BEFORE GOING AHEAD with a study of fluids in motion, we're going to consider fluids at rest. Although we seldom concern ourselves with fluids that are actually at rest, moving fluid systems are often best studied by assuming they're at rest. Effects of motion are then considered separately. The two effects—static and dynamic—are superimposed on each other to get the total pressure, energy, etc.

Fluid statics problems usually involve the relation between pressure, density and height. Pressure at any point in a liquid at rest is due to the weight of liquid above it plus pressure on the liquid's surface. This leads us to the idea that liquid pressure varies directly with height above or below any reference level we choose. (We're assuming liquid's density is constant—a reasonable assumption for most engineering calculations.)

Stated mathematically, the difference in pressure between any two points in a liquid at rest is equal to the vertical distance between points, times liquid density. So, referring to drawing 1:

$$p_1 - p_2 = h \times d = (z_2 - z_1)d \qquad (1)$$

or

$$p_1/d + z_1 = p_2/d + z_2 = \text{constant} \qquad (2)$$

where

p_1 = pressure at pt 1, lb per sq ft
p_2 = pressure at pt 2, lb per sq ft
z_1 = distance from datum to pt 1, ft
z_2 = distance from datum to pt 2, ft
h = distance between pts, ft
d = fluid density, lb per cu ft

Carrying this reasoning to its logical limit, we see that $(p/d + z)$ is the same for all points in the liquid.

We'll put the *p-d-h* relations to work shortly. But first let's review the two pressure systems—absolute and gage. Reference for gage pressure is atmospheric pressure. The Bourdon-type pressure gage measures pressures above atmospheric. So on this gage, atmospheric is zero lb-per-sq-in. gage, or psig. If we're concerned with a pressure below atmospheric we can use absolute zero pressure as a datum. Pressure above absolute zero is lb per sq in. absolute, or psia. Often (in condensing turbine exhaust, for example) we'll measure pressure below the atmospheric datum. Vacuum gage thus reads in inches-of-mercury vacuum. Drawing 2 shows how the gage and absolute systems are related.

Manometers are used for pressure readings where high accuracy is needed —generally over a small pressure range. They're based on the p-d-h formulas (1) and (2).

Drawing 3 shows two mercury manometer hookups used to get static pressure in pipe or the difference in static pressures between two pipes. For case *A* we know that pressure p_1 and p_2 are equal since they're at the same level. Difference in mercury height, 10 inches, represents pressure difference between atmospheric (zero gage pressure) and p_2. So, using formula (1) and considering water and mercury densities:

$$p_2 - p = 15/12 \times 62.4$$

and

$$p_1 - 0 = 10/12 \times 846$$

Since $p_1 = p_2$

$$p = 10/12 \times 846 - 15/12 \times 62.4$$

$p = 627$ lb per sq ft, or

$p = 4.35$ psig

Using the same technique on case *B* and recognizing that p_3 and p_4 are equal, we can figure out pressure difference between the two pipes, p_6 minus p_5:

$$p_3 - p_5 = (10/12 \times 62.4) + (10/12 \times 846)$$

and

$$p_4 - p_6 = 15/12 \times 62.4$$

Since $p_3 = p_4$

$$p_5 = 15/12 \times 62.4 + p_6$$

We then substitute this formula for p_3 into the first equation

$$p_6 - p_5 = 10/12\,(62.4 + 846) - 15/12 \times 62.4$$

$p_6 - p_5 = 678$ lb per sq ft, or

$p_6 - p_5 = 4.71$ psig

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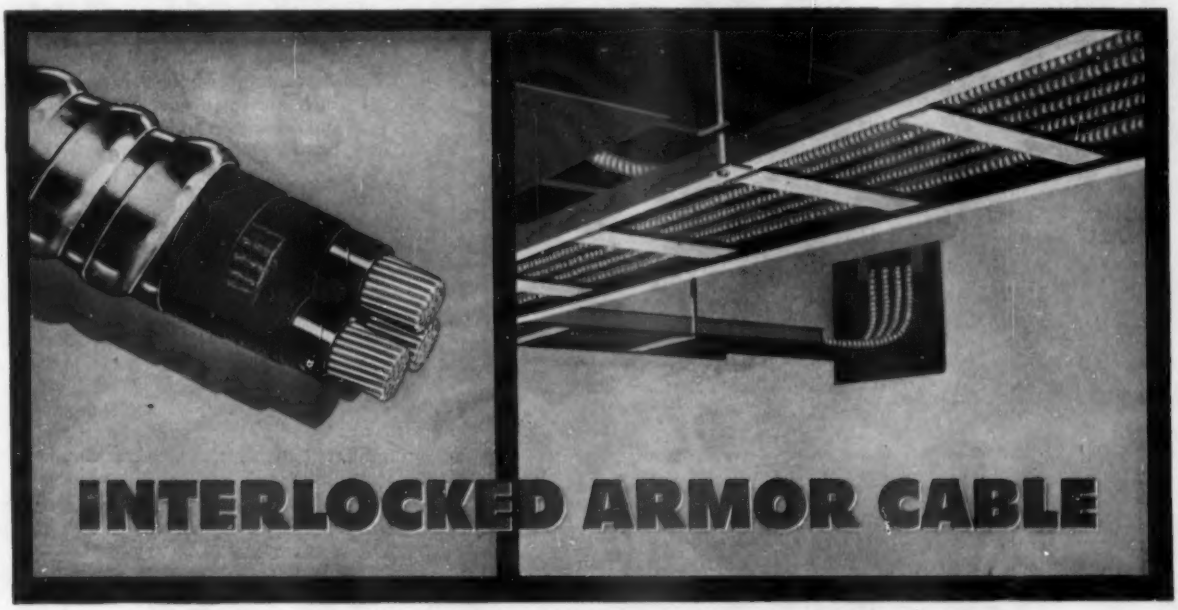

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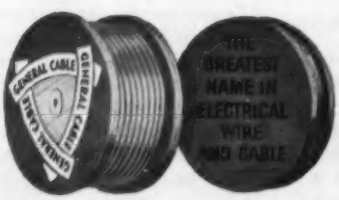

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"If I don't know what's wrong and I'm a turbine expert, what in hell do you think you know about this machine?" yelled the manufacturer's erector

Turbine with the two-year 'jitters'

► EVER LOOK THROUGH old 1880 to 1900 copies of POWER? What an education! Those old-time power engineers had their hands full, what with keeping their coal heavers, ash handlers, boiler makers, machinists and operators on the job.

Those were the days when giant flywheels revolved, engine governors whirled, huge cranks thrashed back and forth, leather belts flapped and hummed in engine rooms that glistened like a well-stocked jewelry store.

The chief engineer of those days wasn't a button pusher. Now I'm not saying that's good or bad. He was a guy who could pitch in and scrape in a giant corliss bearing, line up an engine with piano wire or stop a bad leak in a riveted joint of a red-hot boiler—if he had to. And he could call a tough boiler maker's bluff between rounds of drinks across the street at Mulligan's Tavern and give him a working over —if the occasion called for it.

Those old POWER pages are filled with woodcuts, showing big burly mustached engineers doing all kinds of things in those grand old power plants.

If such ancient scenes don't make you think of our own Marmaduke Surfaceblow—that holdover from those bygone days—then I don't know what will. That's why I ended up at the Bent Propeller Bar yesterday, to get in touch with Marmy and the past.

"BILGEWATER on ancient power plants," croaked Marmy, in his bullfrog voice, when I asked him what he thought of that era. "I'll tell you about taming a turbine that had the experts stopped for two years—and all I did was listen to a smarter guy than myself."

When I asked that question, the old consulting engineer had just stowed away a huge plate of corned beef and cabbage and washed it down with a mug of beer. He had lit a piece of rope yarn and was all primed to sound off when he made that outburst.

His roar quieted the noisy, crowded bar and all eyes turned to our table. When Marmy was sure he had everyone's attention, he continued blasting away in his foghorn voice.

"Back in 1925, I was field erection engineer for a turbine manufacturer. Our firm installed a large turbine in one of the big coal-mine plants in northern Pennsylvania. But the turbine vibrated so badly she couldn't pass her acceptance test.

"That plant supplied electricity to three other mines. The new turbine was a straight reaction type, driving a 10,000-kw electric generator. Considered a giant in those days, she turned 1800 rpm and used 250 psi steam at 550 F.

"The turbine-generator was about 40 feet long. Its foundation was 35 feet above the condenser's foundation below. Exhaust trunk going down to condenser had two copper expansion joints. One expansion joint was under the turbine, the other on the condenser, with a distance piece between.

"To give you dry-land engineers some idea of how big that unit was, the cast-iron distance piece was 10 feet in diameter and about 12 feet long. It was supported by structural steel so its weight wasn't resting on the lower expansion joint. The condenser was mounted on springs.

"Vibration started as soon as the turbine got up to full speed and load was thrown on the generator. Our erec-

(*Continued on page* 186)

The Power Plant Engineer Said:

"I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know—only worked here seven years.*

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

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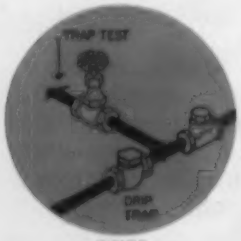

DRIPS

LOOK INSIDE any valve that has failed in close-control steam service. Seating units are scored and grooved beyond repair. Called "wire drawing" or erosion, — it's proof that closely regulated steam acts like a "vapor drill", which quickly knocks out ordinary valves.

Jenkins Plug Type Valves have been engineered in every detail for maximum wear in such valve-killing service. The stainless steel Armor Seat defies the "vapor drill", and Jenkins quality throughout gives them top rating for wear-proof and trouble-proof performance.

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For best resistance to abrasion

your best defense is

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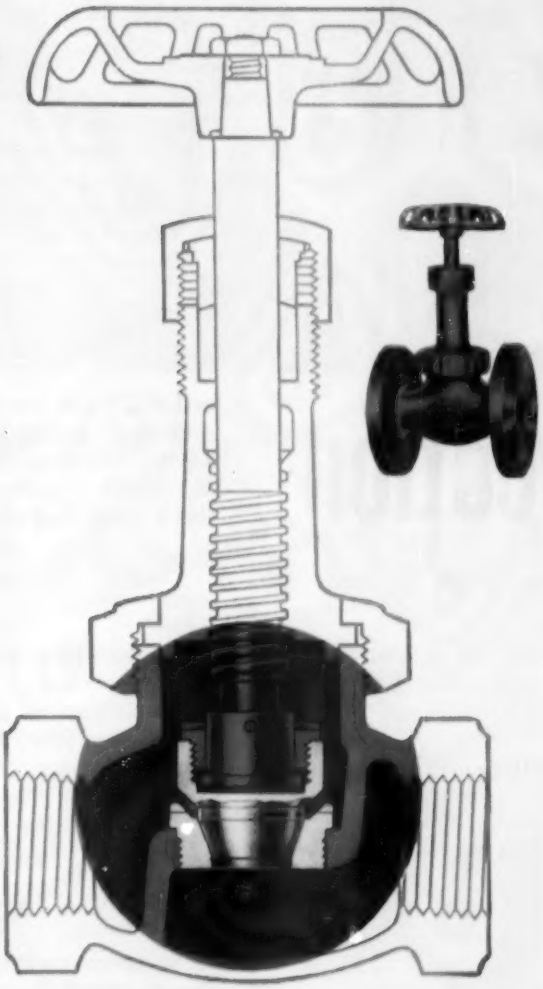
STAINLESS STEEL

Armor Seat



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Reader service section

Start with these quick samples . . .

All eyes on Vienna. . .

as fifth plenary meeting of World Power Conference is called for June 1956. General theme: "World Energy Resources in the Light of Recent Technical and Economic Developments." U.S. National Committee announces program of 25 papers by eminent engineers, scientists, industrialists, government representatives.

Reports From the Field, p 152

Up the pressures, temperatures. . .

to obtain greater heat-rate in steam stations. Prediction: steam conditions in 1976 of 10,000-psia throttle pressure, 1400-F throttle temperature, 1300-F first reheat and 1250-F second reheat. That's the gist of this month's feature technical paper. In all, 17 papers are digested and listed for your quick review. And there's dope on where, how to get your complete report.

Technical Briefs, p 154

Regardless – it's on the level. . .

and that's just one of many features found on the new Otis freight elevator. Compact control assembly keeps car within ¼ inch of landing despite weight variations. Handles loads from 2500 to 20,000 lb. Details of this unit, plus the line on three new diesel engines and a score of other problem-solving developments.

Plant Equipment News, p 158

Best buy in town. . .

is the 2¢ postage stamp that will bring you any of the bulletins described in POWER. Check off those you want on the post cards supplied for your convenience. Stamp and mail – we'll do the rest.

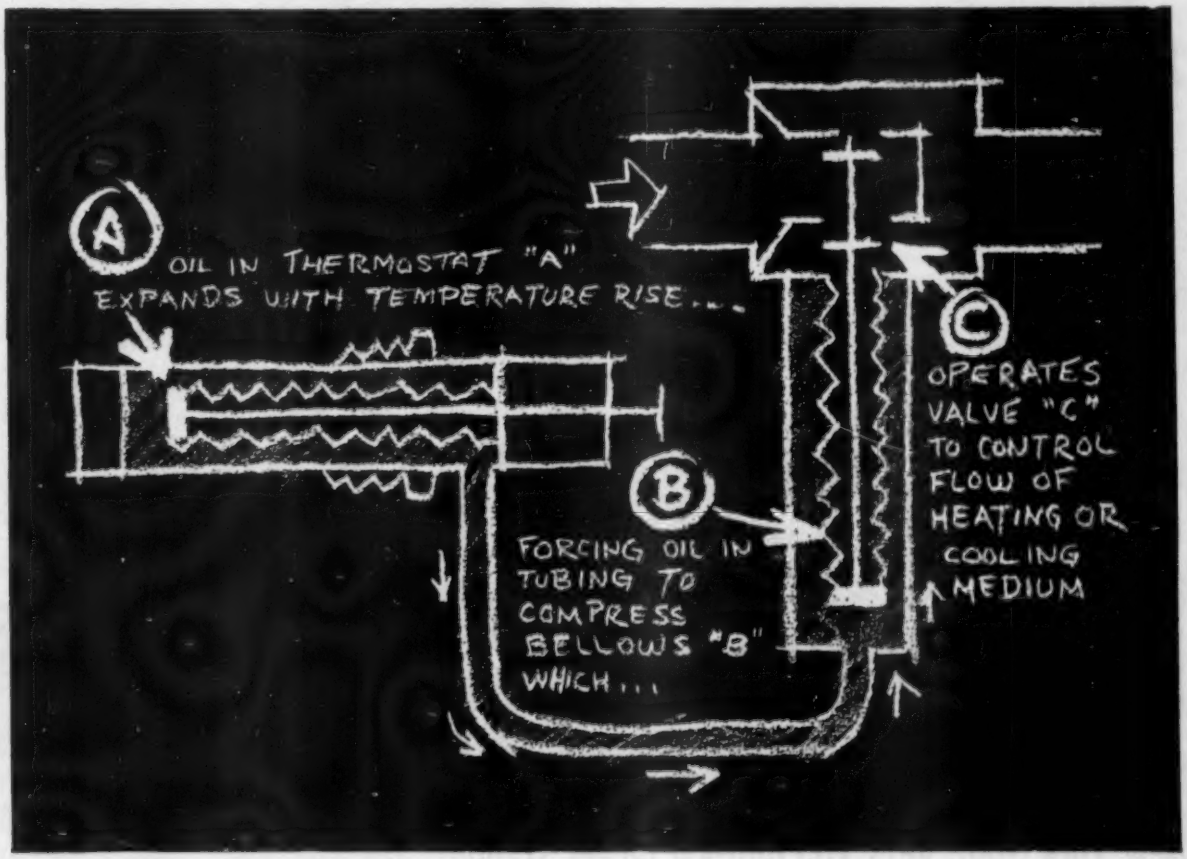
Free Literature, p 167

How do you register. . .

on the ten counts that George Edwards deems foremost among executive qualities? Truthfully answer 'Yes' to all ten and there should be no holding you back.

George Edwards' Scrapbook, p 170

For other timely ideas, see following service pages ▶


A
OIL IN THERMOSTAT "A" EXPANDS WITH TEMPERATURE RISE...
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FORCING OIL IN TUBING TO COMPRESS BELLOWS "B" WHICH...
C
OPERATES VALVE "C" TO CONTROL FLOW OF HEATING OR COOLING MEDIUM

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REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 232

New York State gets 135,000-kw power station

► THE NEW YORK State Electric & Gas Corp's new 135,000-kw Milliken steam-electric generating station has gone into service on a site 15 miles north of Ithaca. The completely inner-cooled electric generator is the largest in upstate New York. Constructed as part of a continuing expansion program, the station is interconnected with the company's five other steam-electric generating stations.

Key to increased power rating, while physical size is reduced, lies in the newly developed inner-cooling system for large turbine-generators. System is designed so cooling agent—hydrogen gas—circulates through inside of the hollow copper conductors. Direct contact between cooling agent and conductor metal carries away heat much faster than in previous designs where cooling agent circulated on outside of insulation around the conductors. This new design applies to both stationary and rotating conductors. Warm hydrogen gas goes to a cooler and then is recirculated through the generator. Milliken Station is designed for an ultimate capacity of 500,000 kw—this being the first unit to be installed.

U.S. to present 25 papers at World Power Conference

► UNITED STATES ENGINEERS, scientists, industrialists and government representatives will present 25 papers on the development of atomic energy, steam and gas turbines and related subjects of power and fuel technology at the fifth plenary meeting of the World Power Conference, according to Gail A Hathaway, Chairman of the U.S. National Committee. The meeting is scheduled for Vienna on June 17-23, 1956.

Most of the 45 member nations are expected to participate. General theme will be "World Energy Resources in the Light of Recent Technical and Economic Developments." United States papers will include:

"Energy Resources of the United

(*Continued on page* 230)

Kentucky coal to be barged to new Tampa power station

► FUEL FOR Tampa Electric Co's new Gannon Station will be shipped by barge down the Mississippi River from Kentucky, and thence across the Gulf of Mexico. It will be the first major utility plant in Florida and the Gulf area to burn coal.

According to W C MacInnes, president of Tampa Electric, possibility of using coal was investigated after increasing cost of fuel oil threatened the stability of power rates in the area.

First unit in this unique plant will be a 120,000-kw General Electric reheat machine. The 900,000-lb-per-hr Babcock & Wilcox steam-generating unit will be of the outdoor type, pulverized fired. Design steam conditions are 1450 psi, 1000 F throttle temperature and 1000 F reheat. Initial operation is scheduled for June 1957

Large surface condenser uses aluminum heat-exchanger tubes

► BELIEVED TO BE the first surface condenser of its size to be fitted with aluminum heat-exchanger tubes is this new 105,000 sq ft Allis-Chalmers unit shown undergoing tubing in the Oak Creek plant of Wisconsin Electric Power Company.

Use of aluminum heat-exchanger tubes was deemed feasible following several years of tests in collaboration with Allis-Chalmers engineers.

higher loads...
economy fuels...
new
engine designs...

there's one answer for all three of these lubrication problems—

Demands upon the lubricant in stationary industrial engines are increasing. More severe operating conditions caused by heavier loads, new engine designs and the use of economy fuels pose difficult lubrication problems not met by conventional oils. Standard Oil Company introduces a lubricant specifically designed to meet these problems—STANODIESEL Oil M.

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Use of STANODIESEL Oil M means this: less engine deposits, less ring and cylinder wear. Less spark plug fouling when used in gas engines. Eliminates fuel injector and pump sticking caused by deposits on the injector barrel and plunger when fuel and lubricating oil commingle.

You need to know about STANODIESEL Oil M. In the Midwest, call your nearby Standard Oil lubrication specialist. You will receive the information promptly. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

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TECHNICAL BRIEFS

Latest engineering developments for busy power men

17 Papers for you on:
STEAM POWER
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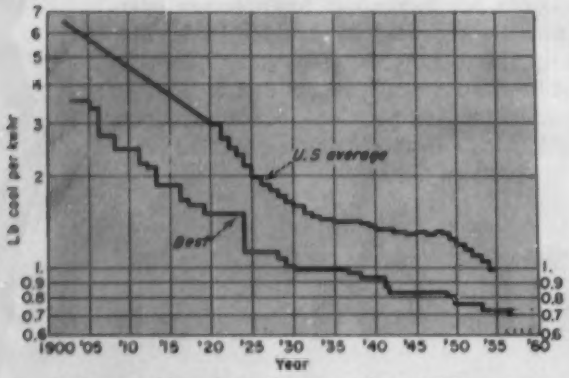
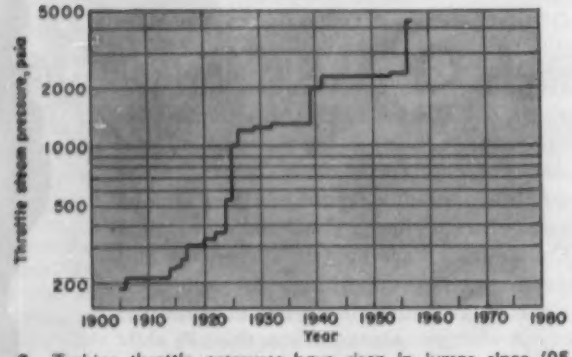
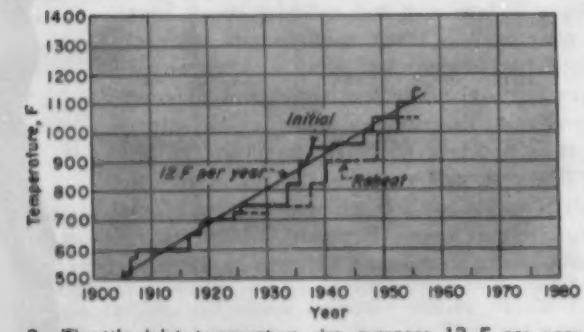


1 Coal consumption by utility plants from 1905 to present



2 Turbine throttle pressures have risen in jumps since '05



3 Throttle inlet temperature rise averages 12 F per year

Forecast for '76: 1-million kw unit—10,000-psia, 1400-F throttle steam

Margins for improvement of the steam cycle. *By J E Downs, General Electric Company.*

This paper discusses heat-rate improvements obtainable in steam stations by increasing initial pressures to 10,000 psig, initial temperature to 1450 F and reheat temperatures to 1400 F. Effect on heat rate of turbine size, reheat pressures, final feedwater temperature, multiple reheat and other variables, are included. Potential gains from the combined steam and gas-turbine cycle are briefly discussed.

Fig. 1 shows the coal rate curve for the U.S. from 1905 to the present. It's interesting to note that the best coal rate, 0.71 lb per kwhr, represents a station thermal efficiency of 40% (excluding a 4% allowance for light-load operation). There obviously is margin for further improvement before violating thermodynamic fundamentals.

The author points out he is not attempting to predict the rate at which further improvements in the heat cycle will be accomplished. In view of complexity of the variables involved and the presently undetermined future effect of the atomic energy cycle, it would be foolhardy to attempt such a prediction. But past history, Fig. 2 and 3, indicate it would be equally foolhardy to predict that further increases in initial pressures and temperatures will not take place.

A number of theoretical regenerative steam-cycle heat rates are computed and plotted in the paper. These cycles include nonreheat and reheat types. Fig. 4 and 5 show effect on heat rate of feed-pump efficiency and of pressure drop from feed-pump discharge to the turbine throttle. Increased importance of these factors at the higher throttle steam pressures is apparent.

If historic trends are followed during the 20-year period from 1956 to 1976, steam conditions in 1976 would be 10,-

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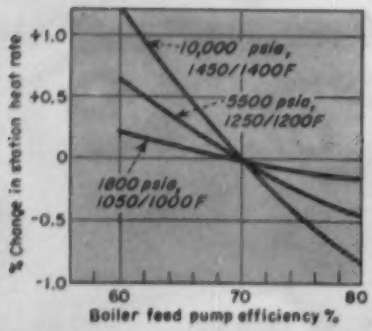
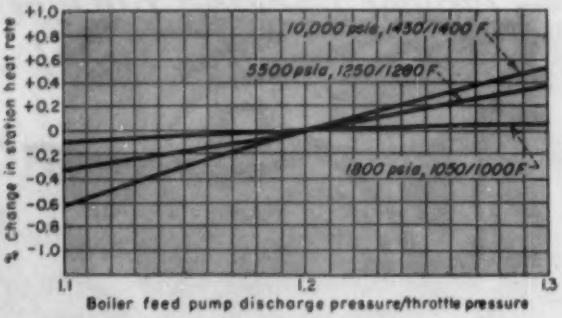
More TECHNICAL BRIEFS

Begins on page 154



4 Feed-pump efficiency affects heat rate



5 Change in station heat rate for different ratios is shown

000-psia throttle pressure, 1400-F throttle temperature, 1300 F first reheat, and 1250 F second reheat. A doubling in turbine size each ten years, starting with a 250,000-kw unit in 1956 would give a 1,000,000-kw turbine by 1976. Such a unit would give a net station heat rate of 7750 Btu per kwhr, or 0.64 lb coal per kwhr.

The author concludes that effective use of higher pressures requires, to some extent, concurrent use of higher temperatures and to a greater extent, use of larger turbine-generator sizes. An additional large gain in heat rate results from use of the combined steam and gas cycle. *ASME paper No. 55-SA-76.*

Directions for ordering papers are given on page 222

Controls

A three-dimension spherical pitot probe. *By James E Ash, and John C Lee, Armour Research Foundation.*

The conventional method of applying the five-hole spherical pitot probe to three-dimensional flow measurements consists of either adjusting the probe until its axis points in the flow direction, or yawing the probe until the meridian plane passing through center orifice contains the flow angle, and then making use of two-dimensional calibration curves for the flow determination in this plane.

Both of the methods require adjustment of the probe, which, in general, is quite difficult to accomplish if probe is mounted upon a rotating impeller. To avoid this difficulty, a five-hole, three-dimensional spherical pitot probe has been developed and calibrated to measure static pressure and magnitude and direction of the velocity vector, for any arbitrary flow angle without adjustment of the probe. *ASME paper No. 55-SA-56.*

Response of temperature measuring elements to thermal transients. *By J A Clark, Massachusetts Institute of Technology.*

Requirements of modern automatic control and regulation demand increased speed of response from all measuring instruments. Not least among these various instruments are those that measure and record temperature—or some property whose change under certain specified and controlled conditions is related to temperature. During any temperature change—the transient period—it is important to have accurate and timely information from those instruments sensing and controlling the temperature.

The author reviews and summarizes what has previously been published on this subject, presents certain new information and, in some instances, amplifies the old. While he has tried to make the review complete, it is expected that some authors will have been unintentionally overlooked. Throughout, an emphasis has been placed upon engineering utility of the results. *ASME paper No. 55-SA-18.*

New schemes for pulsating flow measurement with head-type meters. *By Yao Tzu Li, Massachusetts Institute of Technology.*

Dynamic errors of an ordinary head-type flowmeter under pulsating flow conditions result from inadequate dynamic performance of the differential pressure gage used, plus undesirable effects of the "virtual mass" of the flow-sensing element. Physical aspects of the virtual mass of several types of flow-sensing element configurations are studied in this paper. Schemes for reduction of virtual mass of flow-sensing elements are discussed. A high-frequency perforated vane-type flowmeter and a high-speed linearization computer (adjustable square rooter) are described. Combined flow measuring system is simple and stable and has been tested to give satisfactory results at 30-150 cps. *ASME paper No. 55-SA-79.*

Fluid flow

Flow of a compressible fluid in a thin passage. *By S K Grinnell, Massachusetts Institute of Technology.*

Pressure distribution and weight-flow rate can be predicted for laminar compressible-fluid flow in a thin passage by use of methods presented in this paper. A simplified method can be used readily when fluid forces due to viscous action predominate over those due to acceleration of the fluid. A more complicated trial-and-error method seems to be required for larger passages where, though the flow may be laminar, momentum effects due to acceleration of compressible fluid are appreciable. An experimental apparatus was used to examine validity of the analytical work.

Experimental pressure distributions agree within a maximum deviation of 10% with the theoretical distributions predicted by both comprehensive and simplified theories. Experimental weight-flow rates agree within a maximum deviation of 50% with pre-

(Continued on page 214)

Wickes Boilers selected by one of America's newest, most up-to-the-minute automotive parts and accessories plants

These two Wickes steam generators were installed recently in one of America's most modern automotive parts plants. Each delivers 66,000 lbs. of steam per hour, has a boiler and water wall heating surface of 7340 sq. ft. and an air pre-heater of 5225 sq. ft. Design pressure is 200 psi, operating pressure 250 psi, and water feed temperature 225°F. In factories, institutions, municipal buildings, refineries, processing plants, and many other installations throughout the country, Wickes boilers are supplying dependable, low-cost heat and power. Wickes builds water tube steam generators in a great variety of types and sizes to fill the individual needs of any application. If you are building new facilities, or wish to replace your present steam generator with a newer, more efficient one, contact Wickes. We will be pleased to send you our new 24 page bulletin No. 55-1 containing complete information on Wickes steam generators and fabrication facilities.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • **SALES OFFICES:** Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C.

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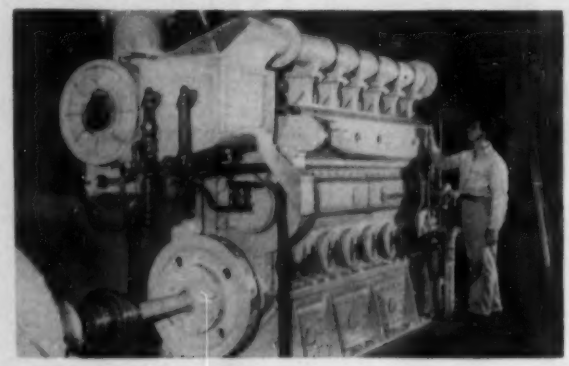
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers

Diesel, dual-fuel, gas engines are rated up to 1400 hp



1101 • Medium-speed, 4-cycle diesel, dual-fuel and gas engines with ratings to 1400 hp feature *Jet-Swirl* turbocharged power. This is a streamlined design for air inlet that brings air in parallel to the inlet valve stem and gives it a swirl as it enters the cylinder. It allows ramming larger and more turbulent air charges into the cylinder—thus giving cleaner and more complete combustion.

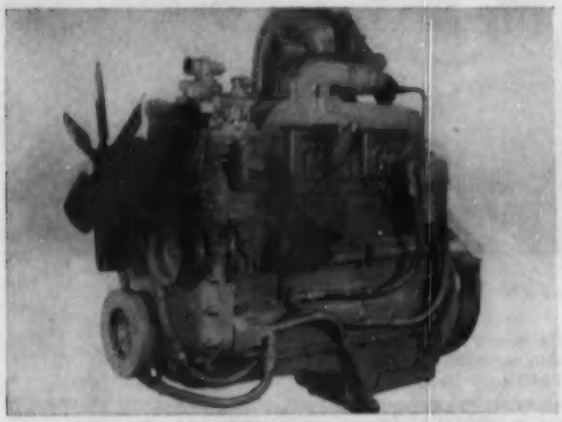
The engines are designed for service in utility and water works, sewage disposal plants, irrigation, pump or blower drive, mining, and mobile power applications. The entire engine is structurally designed for operation at higher than 200 psi, bmep.

The new line, *W 9* operates on residual, crude and distillate oils, natural, sewage, propane or manufactured gas. Welded steel construction affords a low weight per horsepower ratio thus providing lower building, foundation and installation costs.

Designed for medium-sized power package at permanent installations, they are also adaptable for portable and semi-portable services such as temporary power for oil field service or on trailer or rail-car mountings. They may be arranged as a drive unit from either end and may be equipped with any standard clutches, hydraulic couplings, torque converters or other power take-off equipment now on the market.

Crankshaft is hung from the frame; secured by heavy cast steel main bearing caps, and utilizes removable precision bearing shells.

Worthington Corporation, Harrison, N .J.

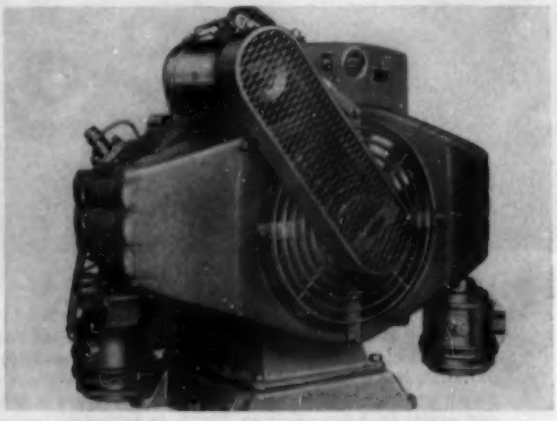


Turbocharged diesel creates added hp

1102 • Two turbocharged diesels, the *NTO-6* and *NT-6*, are available for industrial, automotive and marine use. *NTO-6* develops 262 hp while *NT-6* is rated at 250 hp. Maximum speed of both is 2100 rpm. Both are six cylinder, 4-cycle engines with bore and stroke of 5⅛ x 6 in., piston displacement of 743 cu in. and compression ratio of 15.5 to 1. Weight of each is 2546 lb.

The turbocharger is a simple gas turbine located in the exhaust system. This turbine is connected by a common shaft to a centrifugal blower. Expansion of exhaust gases in turbine chamber puts exhaust heat to work by rotating turbine blades, shaft and blower at high speed. By creating pressure in intake manifold, blower packs a greater weight of air into cylinder. This added air allows a greater fuel charge to be burned completely, thus creating more hp. Turbocharger can be top or side mounted.

Cummins Engine Company, Inc, Columbus, Ind.



Full-diesel engine is air cooled

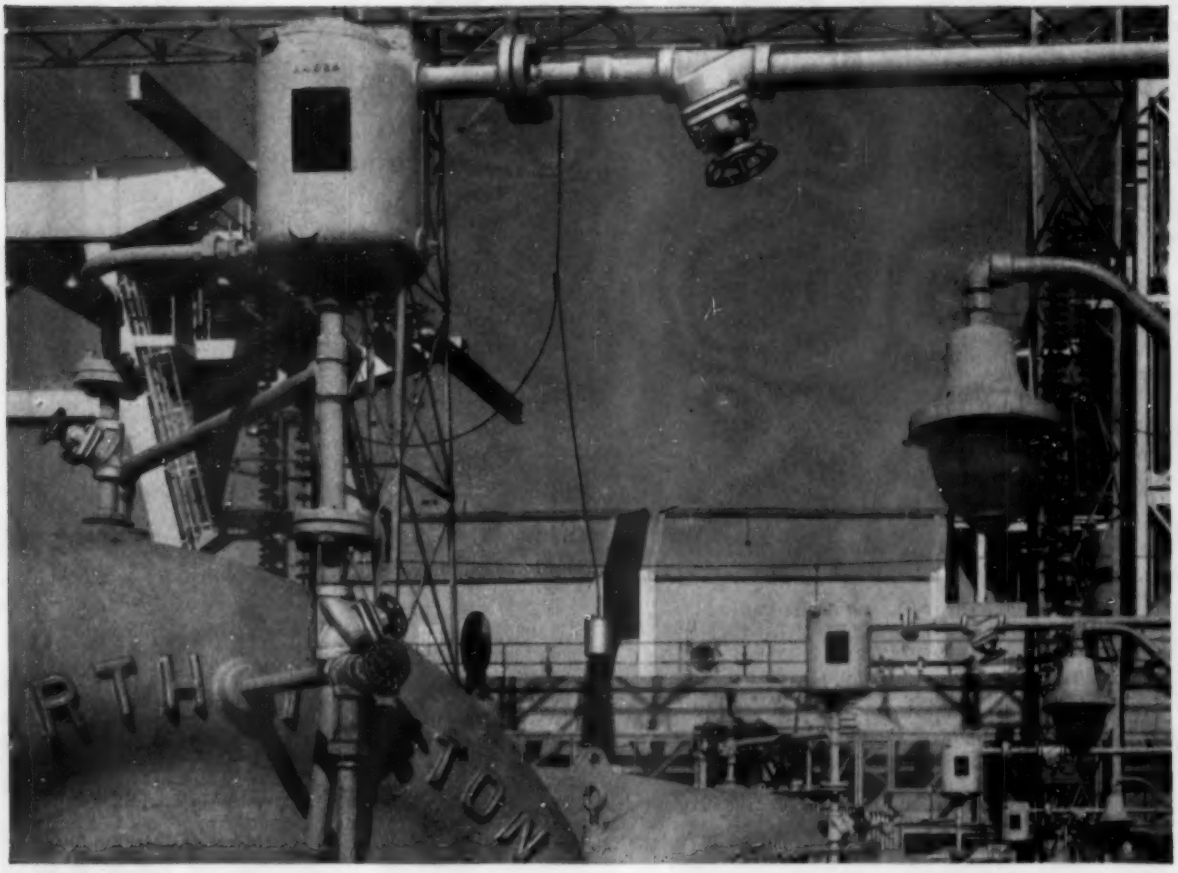
1103 • This air-cooled diesel is being offered for the first time as a separate item. Formerly it was built exclusively as the prime mover for the company's 5000-watt diesel electric generating set.

Model DRP is a 4-cycle, solid injection full-diesel engine—performance rated at 15 hp at 2300 rpm. It has a bore and stroke of 3½ in., piston displacement of 67.3 cu in., compression ratio of 17.3 to 1, and weighs 516 lb. Crankshaft and connecting rods are of forged steel with extra large bearing surfaces. Pistons are of vanasil aluminum alloy and exhaust valves and seats are of Stellite. Unit has full-pressure lubrication.

The 12-volt battery charging generator, 12-volt electric starter, throttle-lever template and timing gage are included as standard equipment. Recommended applications include oil-field pumping, irrigation pumps, air compressors and farm equipment.

D W Onan & Sons Inc, Minneapolis, Minn.

For more data on these items, use post cards p 167. Identify your request with item number.



Corrosive circulating water tamed here by these CRANE VALVES

THE CASE HISTORY—Almost 2 years' operation without any maintenance of valves on circulating water lines to condensers, and on priming and instrumentation systems—with no trouble in sight. That's the experience of Southern California Edison Company's 280,000 k.w. steam station at Etiwanda with Crane Packless Diaphragm Valves.

The plant's engineers knew that sediment in recirculated water would quickly cut out the seats in ordinary valves and its corrosive elements would attack working parts to make valve operation difficult.

Not so with Crane Packless Diaphragm Valves. Their sealed bonnet keeps working parts out of contact with line fluid—free of corrosive effects. Separate disc construction with pliable insert resists erosion—seats tightly even on foreign particles. Large or small, these valves operate easily with fewer turns to the cycle. Typical Crane quality throughout—they're made better to do the job better—a bigger value for the thrifty buyer.

CRANE No. 1610 PACKLESS DIAPHRAGM VALVES

No packing to maintain. Neoprene diaphragm has longer life because it seals the bonnet only—is not subject to the cutting and crushing encountered when also required to do the seating. Separate disc gives control of fluid even should diaphragm fail. Wide selection of materials and sizes. Write for folder AD-1942 or see your Crane Representative.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

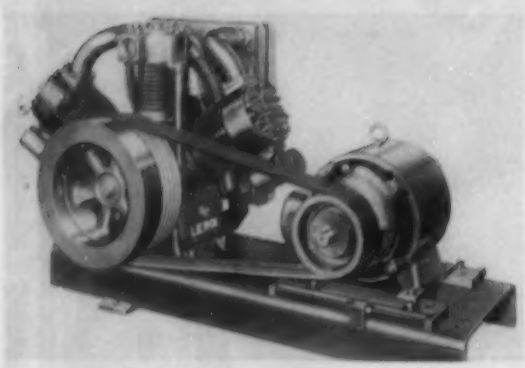
VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

More EQUIPMENT NEWS

Begins on page 158

COMPRESSORS . . . two timely developments designed for today's needs

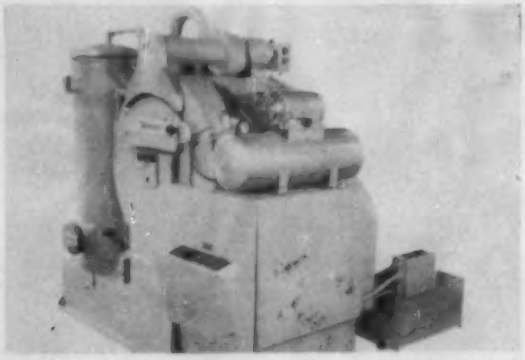


Stationary compressors are air-cooled

1104 • Two-stage compressors, rated 50, 75 and 100 hp, have displacements of 260, 415 and 550 cfm at 125 psi operating pressure. They are electric motor driven.

Both 3- and 6-cylinder units are said to have a balanced design that reduces vibration and noise to a minimum. Cylinders are cooled by a belt-driven fan that draws air through a sectional-core intercooler and directs air over cylinders and heads. A dual control gives operator a choice of start-and-stop duty of both motor and compressor or a continuous running of motor with intermittent compressing.

LeRoi Div, Westinghouse Air Brake Co, Milwaukee, Wis.



Portable compressors deliver oil-free air

1105 • These piston-type compressors are built for continuous operation while delivering up to 175 psi pressure. They may be mounted right where compressed air is needed, thus eliminating need of central compressed-air stations. Oil-free feature makes them particularly suitable for all types of pneumatic tools and controls systems. Photo above shows unit mounted on a dry-cleaning machine.

Graphite or carbon piston rings are used instead of conventional steel rings. Thus no oil is needed for lubricating cylinder walls. Motor and compressor are direct-coupled.

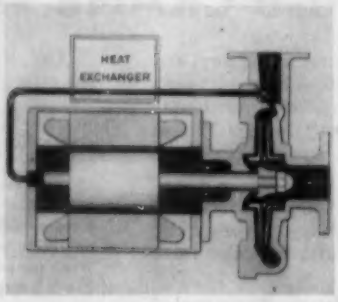
Bell & Gossett Company, Morton Grove, Ill.

PUMPS . . . three modern units for varied industrial applications

Controlled volume pump

1106 • Unit utilizes an air-servo system with feedback loop to give capacity adjustment with an accuracy within 1%. Stroke length is infinitely adjustable from 0 to 100% of full length by means of a reversible rotary air motor. This motor and other components of the pneumatic servo system are housed in a cabinet mounted on the pump base. Four gages show key air pressures at all times. Actual stroke length is indicated by a dial mounted on the pump.

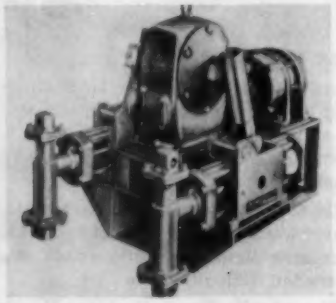
Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.



Canned motor pumps

1107 • These pumps, in ¾, 1½, 5 and 7½ hp sizes, are designed for handling fluids as hot as 1000 F. Pumped fluid enters rotor chamber of combined motor pump. Necked down area between motor and pump sections, see diagram, provides a thermal barrier and narrow restriction for passage of pumped fluid. Secondary impeller circulates rotor chamber fluid through a water-cooled heat exchanger mounted in circulation line. Max head is 195 ft; cap., 250 gpm.

Chempump Corp, 1300 E Mermaid Lane, Philadelphia 18, Pa.



High-pressure pumps

1108 • Reciprocating plunger pumps, for pressures to 50,000 psi, are designed for metering output from 2 cc per hr to 15,000 gph. They are available in simplex, duplex, triplex and quadruplex types—all adaptable to manual and automatic control. Manufacturer states that their design advantages permit up to a 30% reduction in horsepower normally required for the pressures involved. Result: initial, operating and maintenance costs are cut.

Philadelphia Pump & Machinery Co, 1513 Race St, Philadelphia, Pa.

For more data on these items, use post cards p 167. Identify your request with item number.

Now you need

ONLY ONE GREASE

to handle practically every grease job in your plant!

Improved POCO HT Grease

is ideally suited for applications subject to extreme temperatures, moisture, speed and load. Here's why:

- It has a higher melting point than most special "high temperature greases".
- It can be pumped at temperatures as low as −20° F.
- It lubricates completely under conditions of moisture or water.
- It has higher oxidation stability for longer life on the job.
- It provides extremely high protection against rust and corrosion.

Let your local Pure Oil representative tell you how improved POCO HT can cut lubrication costs for you. This may be the only grease you need in your entire plant. Why not call now and find out?

Now it's easier than ever to

"Simplify and Save"

With improved POCO HT headlining Pure's *Multi-Purpose* lubricants, you can now save more than ever with Pure's "Simplify and Save" Plan. Find out how it will work in your plant. Write for full literature. The Pure Oil Co., 35 E. Wacker Dr., Chicago 1, Ill.

Be sure with Pure

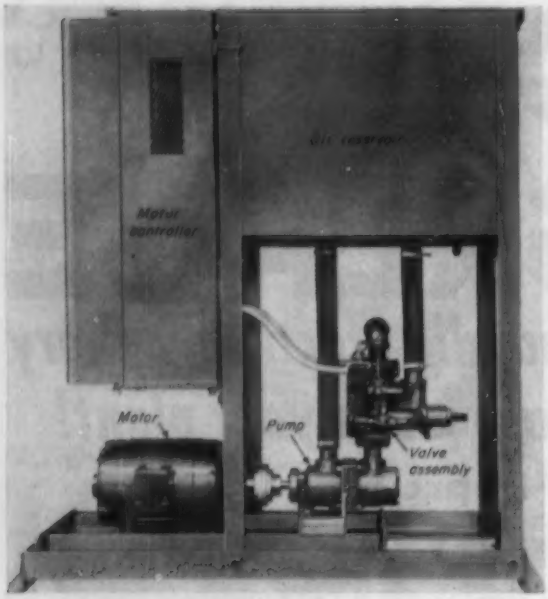
PURE

PURE MULTI-PURPOSE LUBRICANTS

Sales offices located in more than 500 cities in Pure's marketing area.

More EQUIPMENT NEWS

Begins on page 158



Electric-hydraulic freight elevator

1109 • Oil-hydraulic plunger electric elevator is constructed for low-rise freight applications of 2500 to 20,000 lb.

Elevator car platform rests on plunger in a hydraulic cylinder that goes down in the ground as far as the car rises. Oil under pressure—supplied to the cylinder by a motor-driven pump—raises car and piston. Lowering is by gravity. A control valve regulates car down travel when the pump is stopped.

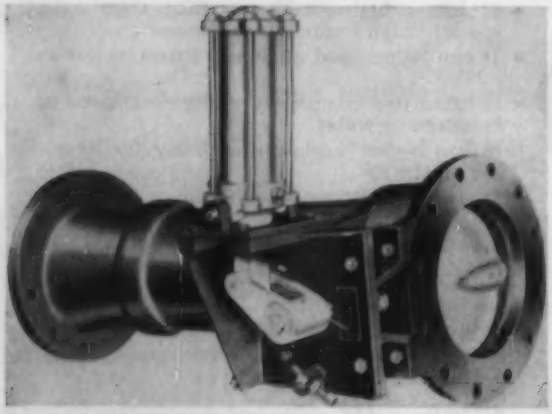
Power unit includes a rotary pump, electric motor, control-valve assembly, oil reservoir and motor controller mounted on structural-steel base. Motor and pump assembly is on an isolating inner base to absorb motor and pump vibrations.

Compact control-valve assembly contains a metered bypass valve, check valve, relief valve, metered lowering and leveling valves and pilot valves—all in a single unit. A heavy-gage sheet steel hydraulic oil storage tank is mounted above valve assembly.

An electro-magnetic controller for starting and stopping the motor contains overload relays to protect against stalling. Control-panel enclosure hinges to power unit frame for easy access. Elevators are single automatic pushbutton operated. To start the car an attendant stationed at a landing or in the car presses the pushbutton. Car goes to selected floor and automatically stops within ¼-in. of the floor, regardless of load or direction of travel. Automatic leveling devices work to keep the car level with landing when car movement requires releveling.

Otis Elevator Co, 260 11th Ave, New York 1, N. Y.

Two possible solutions to your fluid-flow problems



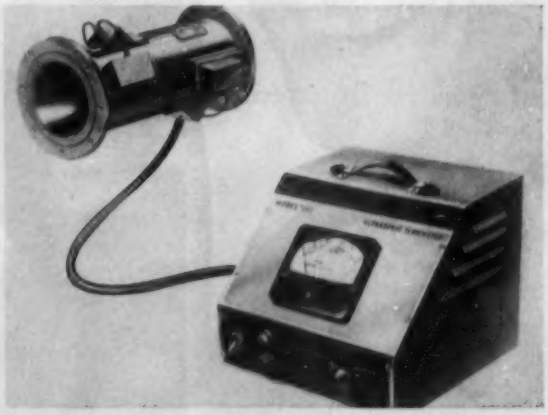
Tight-closing rate of flow controller

1110 • Power-actuated rate of flow controller is designed for the effective operation of water, waste-treatment or industrial plants.

The controller comprises a Venturi metering section and pressure recovery section, power-actuated valve mechanism, and a pneumatic, hydraulic or electric positioning control unit. Its cast-iron body, for working pressures to 125 psi, has pressure-averaging annulus at inlet and closed annular chamber with multiple vents at throat. *Model RCB-T* comes equipped with a rubber-seated butterfly valve to assure tight closure.

According to the manufacturer, control accuracy is within 3% ranging from 25 to 100% of maximum capacity.

Builders-Providence, Inc,
345 Harris Avenue, Providence, Rhode Island



Ultrasonic flowmeter unaffected by variables

1111 • Manufacturer states that this unit measures mass or volume flow of most any fluid. Variations due to pressure, viscosity, gas bubbles, solids in suspension, electrical conductivity or position of installation are eliminated. Pressure drop is virtually zero. Unit has no restrictions or moving parts to obstruct flow or cause pipe clogging.

Rate of volume flow is measured by two transducers, each of which transmit and receive controlled pulses of ultrasonic energy across the pipe section—one diagonally upstream, one diagonally downstream—sensing difference in number of pulses received. Repetition rate of these pulses is proportional to flow velocity. Instrument is converted into a mass flowmeter by adding a third transducer, acting alone, to give density measurement.

Present designs have a capacity to 12,000 lb per min with fluid density range of about 2.5 to 1. It can be adapted to standard pipe sizes to 2 in. Temp limit is -50 to 225 F and to 750 F with special provisions.

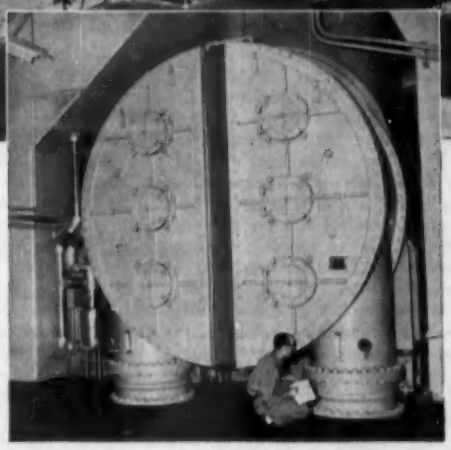
Fischer & Porter Company, Hatboro 35, Pa.

To obtain more information on these new equipment items, use post cards on page 167. Identify your request with item number.

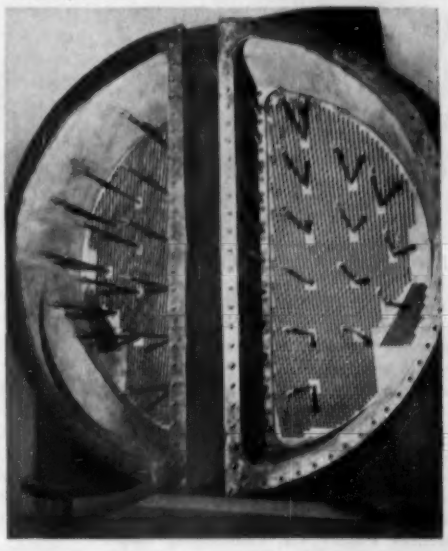
A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.

REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are 7/8" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

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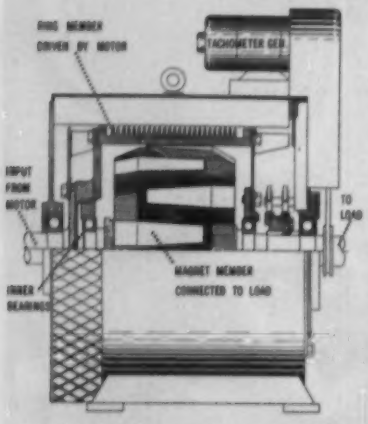
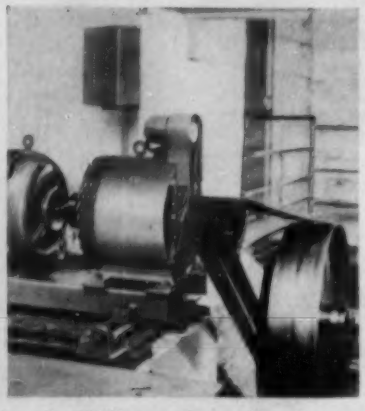
Three mechanical transmission developments





Adjustable speed drive designed for flexibility, wide application

1112 • This unit can be coupled or belted to an existing motor to provide a speed control of ±2% for fans, centrifugal pumps and compressors. It can also handle constant torque loads such as mills, conveyors, machine tools and other applications.

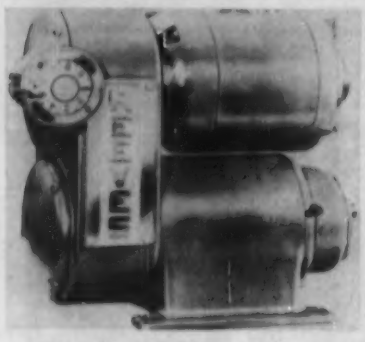
System consists of (1) *Ampli-Speed Drive* installed between motor (or other drive) and the load (2) wall-mounted magnetic-amplifier speed control (3) control rheostat.

The drive itself consists of a "ring member" connected to the input shaft and driven by the motor, and a "magnet member" that is mounted on the output shaft and turns the load. Ring member is driven at constant speed. Magnet member is excited by dc from the control and the dc through the field winding sets up a magnetic attraction between the two rotating members. More field excitation increases the magnetic force between the constant speed ring member and magnet member, so that magnet member speed increases.

Magnetic-amplifier control contains no vacuum tubes or moving parts. It adjusts speed by controlling output of the metallic rectifier supplying field excitation. Speed can be changed by turning control rheostat knob or by an automatic control device.

Unit is designed for motor speeds of 870 and 1150 or 1750 rpm. Horsepower ratings of the two sizes range up to 95 for fan-type loads. For constant torque loads, output ranges to 75 hp, depending upon input speed and required speed range.

Electric Machinery Mfg Company, Minneapolis 13, Minnesota

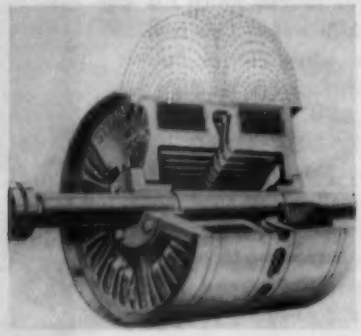


Variable-speed motor drive

1113 • Redesigned unit, for 1-hp applications, occupies maximum space of 16 5/16 x 21½ x 11½ in. (vertical model). Other models are equally compact.

Unit is available in speed ranges from 2:1 through 8:1 and can be obtained in any of 112 different assemblies to meet exact space requirements. "Threaded" spiral-groove lubrication is said to assure complete coverage over all sliding surfaces.

Reeves Pulley Co, Columbus, Ind.



Two-coil magnetic pulley

1114 • Unit is claimed to remove more tramp iron than larger units on many conveyor operations. Further, the two-coil design produces a more effective flux pattern with deeper magnetic field at center of the pulley—a pattern that conforms to normal conveyor load conditions. Two-coil construction is available in widths and diameters ranging from 12 to 60 in.

Stearns Magnetic, Inc, Milwaukee 46, Wis.

Dual-purpose wire

1115 • This wire can be used both as a building wire and machine tool or appliance wire—permitting an industrial concern to stock only one type of wire for either use.

Called *Densheath 900* it consists of a bare copper conductor insulated with an oil and moisture resistant *Densheath* (polyvinyl chloride) 90 C compound and slipper compound over-all for ease of pulling in conduits. The wire is rated at 600 v. It is recommended for use where continuously high temperatures are encountered and for machine tools and heavy-duty appliances. Available in sizes 14 AWG to 2000 mcm when used as TW; in sizes 14 to 4/0 AWG when used as an appliance wire.

Anaconda Wire & Cable Co, 25 Broadway, New York, N. Y.

New slide rules speed conveyor belt design

Two slide rules, so simple they can be used by a layman, have cut time needed to design a conveyor-belt installation from three hours to ten minutes, according to company.

The slide rules are a horsepower calculator and carcass, or belt-fabric selector. Five settings on the hp calculator will give hp needed for 98% of conveyor-belting systems. A maximum of seven settings will yield the drives for level, incline or decline, manually-operated tripper and self-tripper systems.

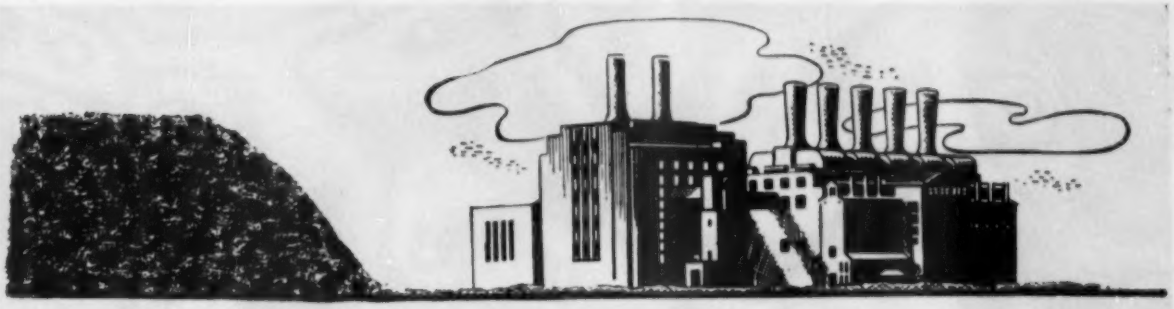
Carcass selector will pick right belt fabric for any system, as well as maximum and minimum number of plies for proper troughing and minimum pulley diameters for take-up, drive, tripper and idler pulleys.

The slide rules are part of a kit that makes it possible to make over 2000 different sample conveyor belts. For further information, write *U.S. Rubber Co, Rockefeller Center, New York 20, N. Y.*

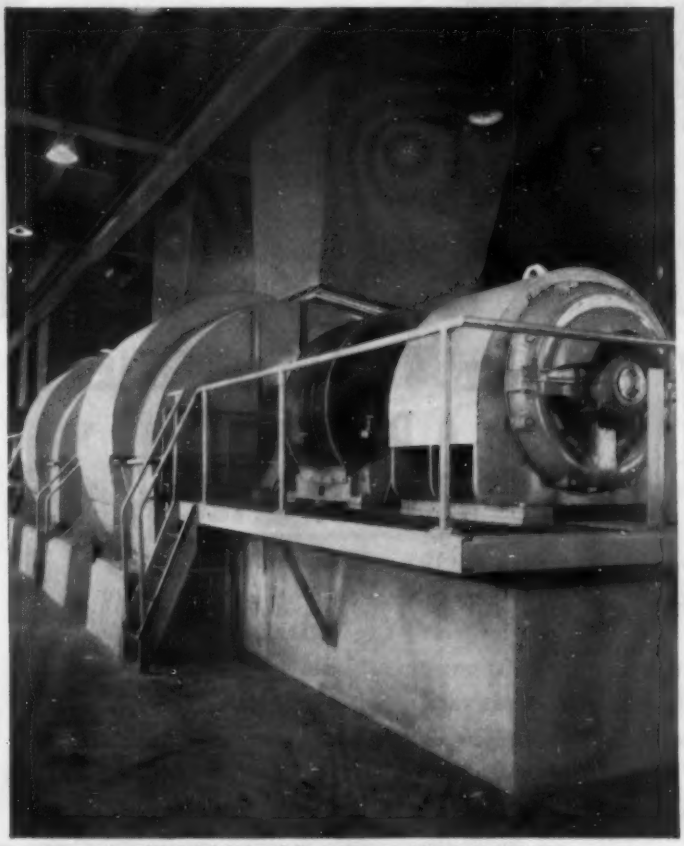
CHECK THESE TOO . . .

Ash gate, feed-housing unit . . p 172
Bin-level indicator . . . . . p 174
Multiple-outlet header . . . . . p 174
Forged-steel gate valves . . . . . p 176
Packaged boiler units . . . . . p 178
Coil-testing instrument . . . . . p 178
Float, thermostatic traps . . . p 180
Screwed-bonnet globe valves . . p 180

For details on these items use post cards p 167. Identify request with item number.



YOUR AIR SUPPLY MUST BE DEPENDABLE, TOO!



The modern "Buffalo" Induced Draft Fan provides stable performance over a wide range of loads in today's high-resistance boiler systems. Its modified radial blade medium speed design, with low velocity through rotor and housing, is especially suited to counteract the severe abrasive action of hot fly-ash.

SPECIFY "BUFFALO" DRAFT FANS

FOR DELIVERY YOU CAN COUNT ON

Since air is as important to combustion as fuel, why take a chance on your draft? "Buffalo" Mechanical Draft has more than earned its reputation for reliability over half a century in many of the biggest utility stations and plant boiler rooms. That's due to the "Buffalo" "Q" Factor*, the standard we've always held to: "build it up to the job, not down to a price." And users have reaped the benefits of longer fan service, fewer draft timeouts, easier maintenance — cheaper power output. "Buffalo" Induced Draft Fans, Forced Draft Fans, Primary Air Fans, Overfire Blowers and Diesel scavenger Fans are ready to do the same for you, too.

Write today for Bulletin 3750 for valuable engineering advice and facts on the fans for your power job!

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

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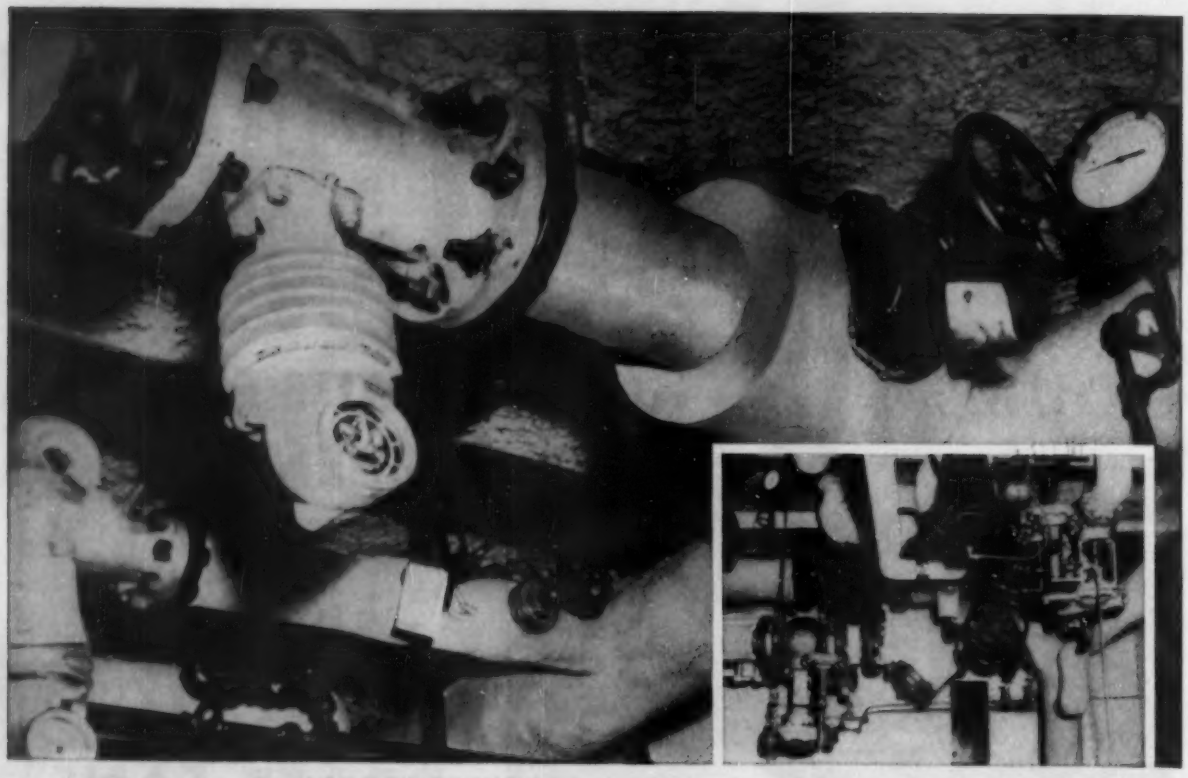
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



FOUND NEW STEAM REVENUES BY A DISTRICT HEATING COMPANY!

In February of this year, *Builders Dual Ranging Shuntflo Meters* "put the finger" on 206,000 pounds of steam which otherwise would have gone unmetered at a major housing project. These Meters produced $267.80 of additional steam revenue in one month alone for the district heating company.

This is typical of what can be expected from this low cost metering system. Using Dual Ranging Shuntflo Meters with Squires Pressure Reducing and Regulating Valves, district heating companies and industries can now recover the bottom 10% of steam consumption now going unmetered. Here's an investment that pays for itself in a matter of months — the quickest and easiest way to gain new steam revenues without increasing steam rates. This system can also be supplied for dual metering of gas or air.

We will gladly send you technical reprint REF. No. 100-K29, giving complete details on this money-making system. Write, today, to Builders-Providence, Inc., 354 Harris Avenue, Providence 1, Rhode Island.

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DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS

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Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

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HEATING AND VENTILATION

1 **Heat equipment.** Illustrated 8-p bulletin 108 contains data on gas, oil, combination burners, heat exchangers, air heaters, combustion and heat-transfer equipment. Thermal Research & Engineering Corporation, Conshohocken, Pa.

2 **Multi-pass electric heater** for heat-transfer fluids and viscous liquids. Illustrated 4-p bulletin 102.1 contains complete specs, skeletonized views, flow diagrams. Hynes Electric Heating Division of Turbine Equipment Company, Mountainside, N. J.

3 **Electric furnaces and ovens** are discussed in 24-p bulletin G-1. Contains dimensions, specs, temperature and control info of general-purpose electric furnaces, high-speed electric furnaces, recirculating furnaces, electric ovens and industrial box furnaces. Cooley Electric Manufacturing Corp, Shelby and Daly Sts, Indianapolis, Ind.

4 **Electric heating elements** for industrial commercial and domestic use. Fully illustrated 24-p bulletin EC-53 contains application, selection data on tubular heaters, immersion heaters, strip heaters, and custom-made heaters. Cutler-Hammer, Inc, 294 N 12th St, Milwaukee, Wis.

5 **Ventura fans** for industrial ventilation. Illustrated 4-p bulletin 6514 outlines construction features, performance data, capacities and weights of the 45 different direct-drive fan units available in *Model K* line. American Blower Corp, Detroit 32, Mich.

BOILERS AND AUXILIARIES

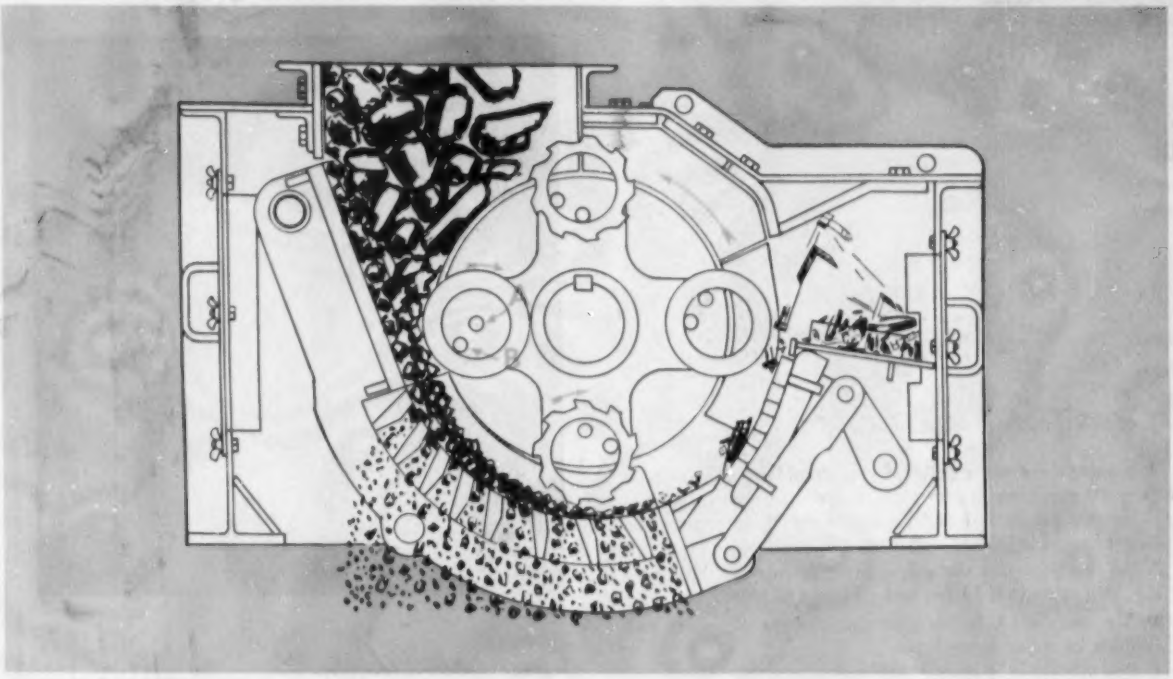
6 **Boiler-plant instrumentation.** 24-p bulletin 55-605-33 contains photos, schematic drawings of combustion guides, draft gages, flow, level, temperature and pressure instruments, combustion control systems and panels. The Hays Corp, Michigan City, Ind.

7 **Steam generators,** package units, in capacities from 10,000 to 40,000 lb of steam per hr, in three standard pressures of 175, 250 and 375 psig, are described in 10-p bulletin PSG-2. Contains photos, design and construction details, full specs. Henry Vogt Machine Co, Louisville 1, Ky.

8 **Open-blast burner nozzles** for air/gas mixtures are subject of illustrated 4-p bulletin H-15. Contains complete dimension info, operating data and installation instructions. Eclipse Fuel Engineering Co, 1002 Buchanan St, Rockford, Ill.

9 **Boiler control.** Unit, for pressures to 250 lb, can control boiler feed pump from boiler water level; provide low-water fuel cut-off; close an electrical circuit when low water occurs. Full description in 4-p bulletin L-119. McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago 18, Ill.

(*Continued on page* 208)



TWIN SUSPENSION BARS Give Operators Big Advantage In PENNSYLVANIA COAL GRANULATORS

Each row of Crushing Rings is hung on a *pair* of Suspension Shafts, "A" and "B". When running empty the rings are centrifugally balanced on shaft "A" but when they come in contact with the feed the rings are snubbed down against the coal by shaft "B" giving smooth positive crushing action. Conventional ring mills require increased speed of the rotor to hold the rings against the feed and at best the rings rock back and forth with a jerky crushing action, resulting in greater power requirement, increased wear and fines. Twin Suspension Bars and other exclusive improvements, such as the worm gear, link and lever Cage Adjustment, put Pennsylvania Coal Granulators far out ahead in ring hammermill design. Send for Bulletin #9003 that gives the complete story.

Pennsylvania has been designing and manufacturing crushers for over 50 years. Make use of the help our engineers can give you — they have over 100 cumulative years' experience.

patented exclusive feature

provides more positive

uniform crushing at slower speeds

... lower power requirements

... less overgrinding

PENNSYLVANIA

BRADFORD BREAKERS
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IMPACTORS • JAWS
SINGLE ROLLS

PENNSYLVANIA CRUSHER DIVISION

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PE-200

George Edwards' Scrapbook

Executive qualities?

A topnotch executive believes you should be able to pass these 10 questions to rate high in executive qualities.

1. Do you get excited and flurried when unforeseen events jeopardize your plans?
2. Do you belong to the easy-going fraternity of those who say, "I'll cross that bridge when I come to it"?
3. Are you a good, fair or poor judge of the character and abilities of those around you?
4. Can you select, from the men and women you work with, the one best fitted to take charge of your work and direct it efficiently?
5. Can you delegate authority to others? Or, instead of taking the trouble to explain the job, would you rather do it yourself?
6. Have you ever supervised successfully any joint endeavor in your work, or church, or club?
7. Can you bestow deserved praise without making the complimented workers complacent and lax?
8. Can you censure a careless worker, leaving him not resentful, but eager to do his work more efficiently?
9. Have you the ability to make others enthusiastic about their jobs?
10. Are you ready to accept the risks and personal sacrifices inherent in any top position? Or do you prefer the greater security and more comfortable leisurely life that goes with less responsibility?

Going up?

Your firm may be standing still, but not the elevator manufacturers. And the reason is their new operatorless elevators. We understand that these new elevators account for 92% of all passenger elevator sales in the U.S. That's an increase of nearly 800% since 1950.

Don't worry about fuel

Have you ever wondered where the fuel for our new atomic reactors will come from? If you have, stop wondering now. Westinghouse scientists report that there is 23 times more energy in the earth's nuclear-fuel reserve than in all its conventional fuels combined. One pound of processed uranium contains the energy value of 1300 tons of coal or 230,000 gallons of fuel oil. Now that we know fuel isn't the big problem, let's go into high gear and put atomic power plants over with a bang.

Do you like math?

"Mr Steinmetz, what is the cubic content of a metal which is removed from a cylindrical rod two inches in diameter when a 2-inch hole is bored through the rod at right angles, separating it into two pieces?"

The mathematical wizard furrowed his brow, then his face brightened and he said, "Why, of course, gentlemen, the answer is 5.33 cubic inches." The wizard's distinguished scientist visitors were dumbfounded that such a complicated problem could possibly be worked in one's head.

Yet, what subject do you think Steinmetz almost failed in when he started grammar school in Germany? You guessed it, arithmetic. So if you have trouble mastering a subject first time you tackle it, don't feel too badly. Steinmetz didn't. Above is Steinmetz at height of success.

Why power skyrockets

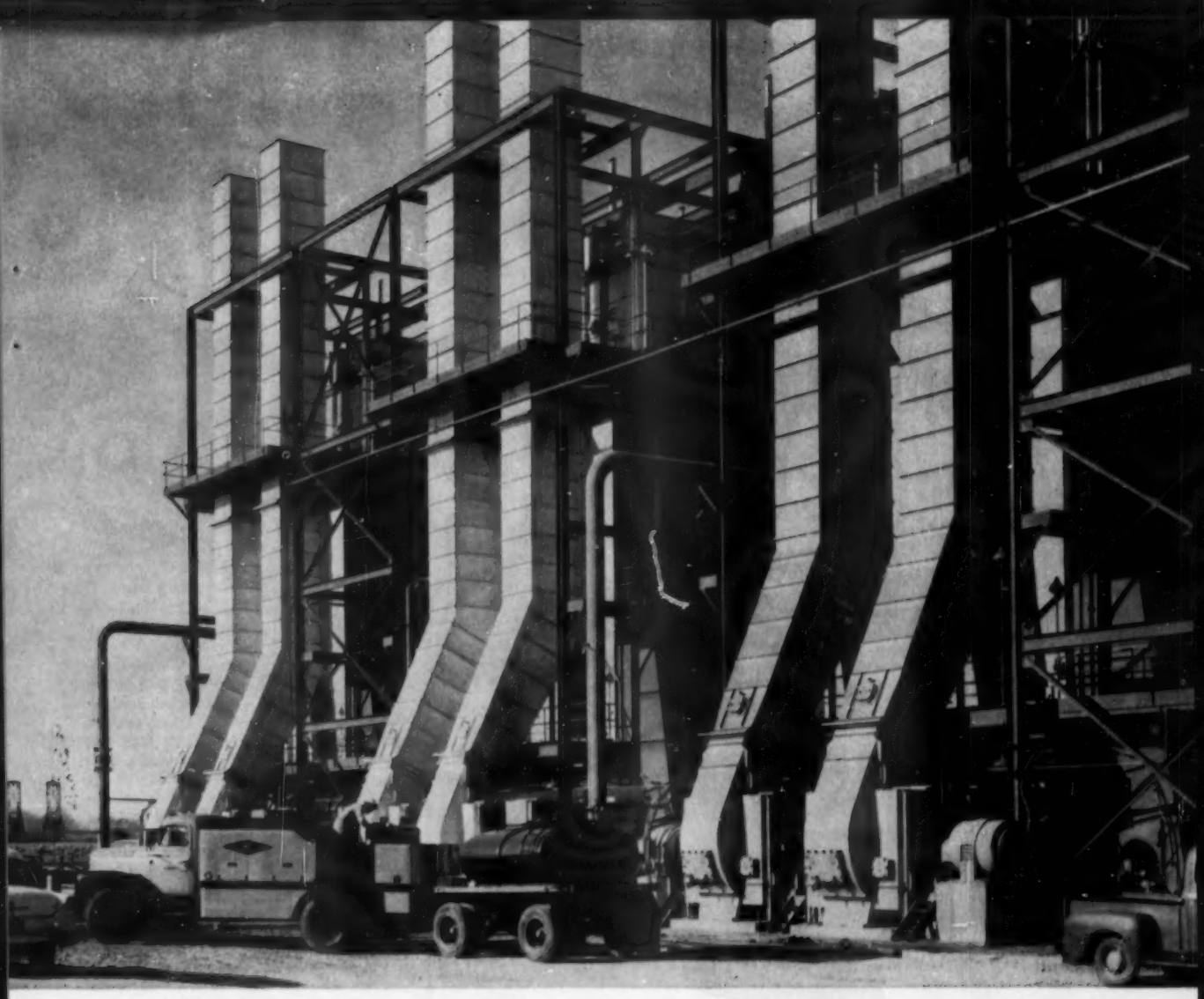
Marketing experts at Westinghouse looked into their crystal ball and what do you think they saw? Every home in the nation will buy an average of eight new electrical appliances in the next five years. That makes a grand total of 428,000,000 new products that we'll be asked to supply with power. That means more power equipment, more responsibility for us power people.

Learn to give

If we noticed little pleasures as we notice little pains—if we quite forgot our losses, and remembered all our gains—if we looked for people's virtues, and their faults refused to see—what a comfortable, happy, cheerful place this world would be.—*Tampa Sun Dial*

George Edwards

Engineer



BOILER TUBE FAILURES ELIMINATED

Regular program of DOWELL chemical cleaning for six boilers ended tube failures due to scale

The tubes of a 500,000 pph boiler in a chemical plant contained an extremely hard high-silicate scale up to 1/16-inch thick. Mechanical cleaning was unsatisfactory, because it required a long shutdown and still left hard scale in the tubes.

Dowell engineers formulated a special solvent and quickly removed the scale from the boiler. The operator now has all six of the 500,000 pph boilers on a regular schedule of Dowell chemical cleaning. Since the beginning of this program, the boilers have been cleaned several times and there have been no tube failures caused by scale deposits.

Chemical cleaning is designed to add years of life to your equipment by helping to protect it from over-heating, galvanic attack, and pitting-type corrosion. Downtime is held to a minimum, because solvents are introduced through regular connections . . . extensive dismantling and scaffolding are not needed.

Dowell Service brings you over a decade of experience in the chemical cleaning of many kinds of equipment, including more than 10,000 high- and low-pressure boilers. Contact the nearest Dowell office for more information. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. A-23.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

high heat release combustion equipment by

THERMAL

Unique results can be had in existing or new heat equipment through the use of the high velocity flame characteristics of THERMAL burners. Heat release rates of 10,000,000 Btu/hr/cu ft are easily obtained. Let us analyze the effects possible on your furnaces, ovens and heat equipment or describe the specialized heat equipment designed and built by THERMAL.

For a summary of THERMAL Products & Services, write for Bulletin # 108

OTHER THERMAL PRODUCTS & SERVICES

GAS, OIL & COMBINATION GAS-OIL BURNERS
HEAT EXCHANGERS • AIR HEATERS
SUBMERGED COMBUSTION
COMBUSTION & HEAT TRANSFER ENGINEERING

THERMAL

Thermal Research & Engineering Corp.

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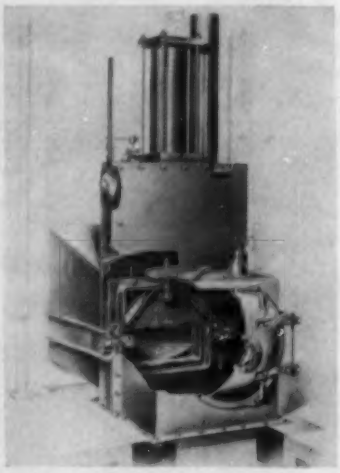
REPRESENTATIVES IN PRINCIPAL CITIES

More EQUIPMENT NEWS

Begins on page 158



Ash gate, feed-housing unit

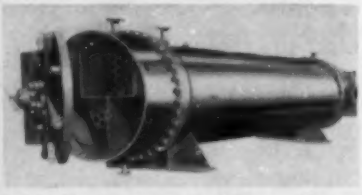
1133 • New ash gate and feed-housing unit is designed for installation on flooded-type bottom ash hoppers.

The hydraulically operated, vertical-lift-type gate is available with either 2 or 3-ft wide openings. A wedging device which holds the door tight in the closed position operates in this manner. Two lugs cast integral on the door engage wedging-cams during downward (closing) stroke of the door. These engaged cams rotate on stationary shafts to thrust door against the frame.

Each cam is counterweighted to swing free of door lugs when door is raised, while a stop limits movement of cam and positions it for next downward movement of door. Cam setting can be adjusted by turning shaft with wrench from outside. Hydraulic cylinders for operating the gate are available for fresh water or oil operation. Parts can also be supplied for clean salt water operation.

The Allen-Sherman-Hoff Co, 259 E Lancaster Ave, Wynnewood, Pa.

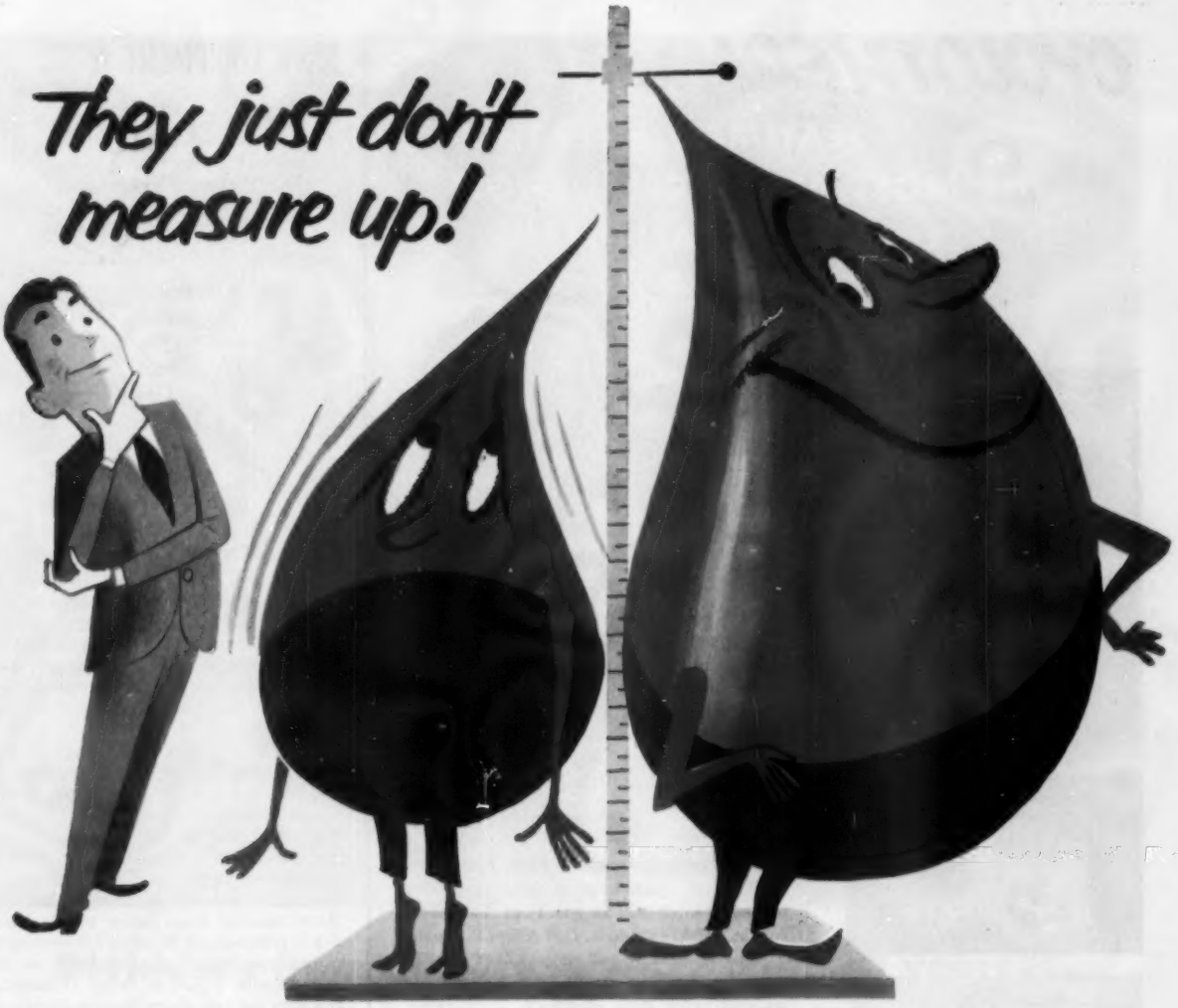
For more data on these items, use post cards p 167. Identify your request with item number.



Quick-opening exchanger door

1123 • Self-seating door considerably reduces time to open heat exchangers, autoclaves, sterilizers and other pressure vessels. It is locked and unlocked by means of bars—taking about five seconds to open, according to manufacturer. The unit is capable of withstanding temperatures from -70 to 400 F.

Bars on the door are inserted into and withdrawn from fittings in the vessel by a hand-operated lever. The lever, located at center of door, opens with a turn of



When you're offered oils "just as good" as Gargoyle D.T.E., remember these facts...

Have you ever wondered why, so very often, you're urged to buy an oil that's "just as good as Gargoyle D.T.E."? The reason is simple...Industry has always accepted Gargoyle D.T.E. hydraulic oils as the *standard of quality* in this field!

These substitutes may have *some* of Gargoyle D.T.E.'s properties—but *none* measures up in all-round performance! Gargoyle D.T.E. hydraulic oils last longer—have given excellent service, in many cases, for thousands of hours! They boost machine efficiency—improve production and quality—help reduce manufacturing costs. That's why—although Gargoyle D.T.E. costs a trifle more (often as little as *one mill* per machine per hour) they actually save you money in the long run!

And here's an *extra* plus . . . the world's greatest lubrication engineering service goes with these famous oils—*at no extra cost!* So why settle for less than the best? Call us today!

Socony Mobil

Correct Lubrication

FIRST STEP IN CUTTING COSTS

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION
Formerly Socony-Vacuum Oil Company, Inc.

CYCLOTHERM...

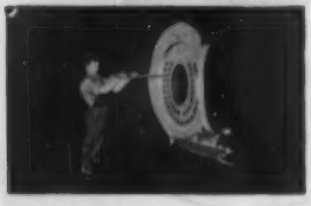
FEATURE for FEATURE THE MOST ADVANCED DESIGN in STEAM GENERATION!

See Our Exhibit
Cyclotherm Booth 181
Chicago Exposition of POWER and MECHANICAL ENGINEERING
Chicago Coliseum
November 14 to 18, 1955

1. Most Compact For More Efficient Space Utilization! You can devote more space to storage and production. Or, you may need less space than you think. Cyclotherm requires minimum boiler room space. It has 40% less floor area and 75% less height than conventional units . . . is up to ⅓ smaller than other packaged units.

2. More Efficient Operation Reduces Fuel Costs! Cyclotherm guarantees a minimum 80% efficiency in oil and/or gas. Fuel changeover can be quickly made as fuel prices fluctuate. From cold start to full power takes only 15 to 20 minutes. Capacity can be reduced without losing peak efficiency.

3. The Finest Service Facilities in Steam Generation! *A nation-wide network* of factory-trained servicemen are available at any hour, weekdays and weekends.



4. Simplified Maintenance Saves Up To 50% In Costs! One maintenance man can clean return tubes . . . replace and clean burner nozzle. Firetube never needs cleaning.

Cyclotherm Steam and Hot Water Generators range from 15 to 500 hp . . . from 15 to 200 psi. For complete details on their many space- and cost-saving features, mail this coupon today for your free booklet.

YEARS AHEAD IN STEAM GENERATION
CYCLOTHERM®
Steam & Hot Water Generators

Cyclotherm Division, National-U.S. Radiator Corp.
2525 E. First Street, Oswego, N.Y.

Please send me a free copy of your booklet giving full information on Cyclotherm Steam and Hot Water Generators.

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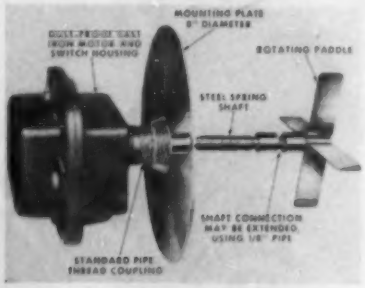
ADDRESS .....
CITY ..... ZONE ..... STATE .....

More EQUIPMENT NEWS

Begins on page 158

60 degrees and with about a 15-lb pull. The door can be swung open manually or by means of a pneumatic cylinder.

The Patterson-Kelley Co, Inc,
10 Lackawanna Avenue,
East Stroudsburg, Pa.


MOUNTING PLATE 8" DIAMETER
DUST-PROOF CAST IRON MOTOR AND SWITCH HOUSING
ROTATING PADDLE
STEEL SPRING SHAFT
SHAFT CONNECTION MAY BE EXTENDED USING 1/8" PIPE
STANDARD PIPE THREAD COUPLING

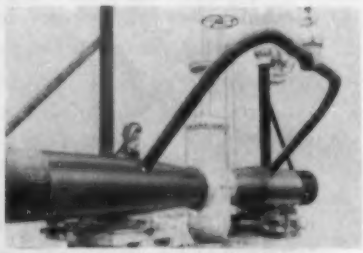
Bin-level indicator

1128 • Unit is particularly adaptable to installations in bins under pressure or vacuum; bins, chutes or conveyors handling materials containing large lumps which tend to "bridge" over a diaphragm; and bins handling materials that tend to "rathole" and prevent operation of a diaphragm.

Unit has a slowly rotating paddle, mounted on a flexible shaft. This projects into bin and is driven by a small motor mounted in a housing outside the bin. When material in bin partially or entirely covers paddle, rotation of paddle is stopped and torque exerted by motor actuates a Micro-switch in the motor housing. When material drops below paddle, rotation is resumed and Micro-switch returns to normal position. The shaft flexes as required under impact or thrust of material and does not take on permanent distortion. Being flexible, it sheds top loads and retains its freedom to move as required.

The Bin-Dicator Co, 13946-152 Kercheval Ave, Detroit, Mich.

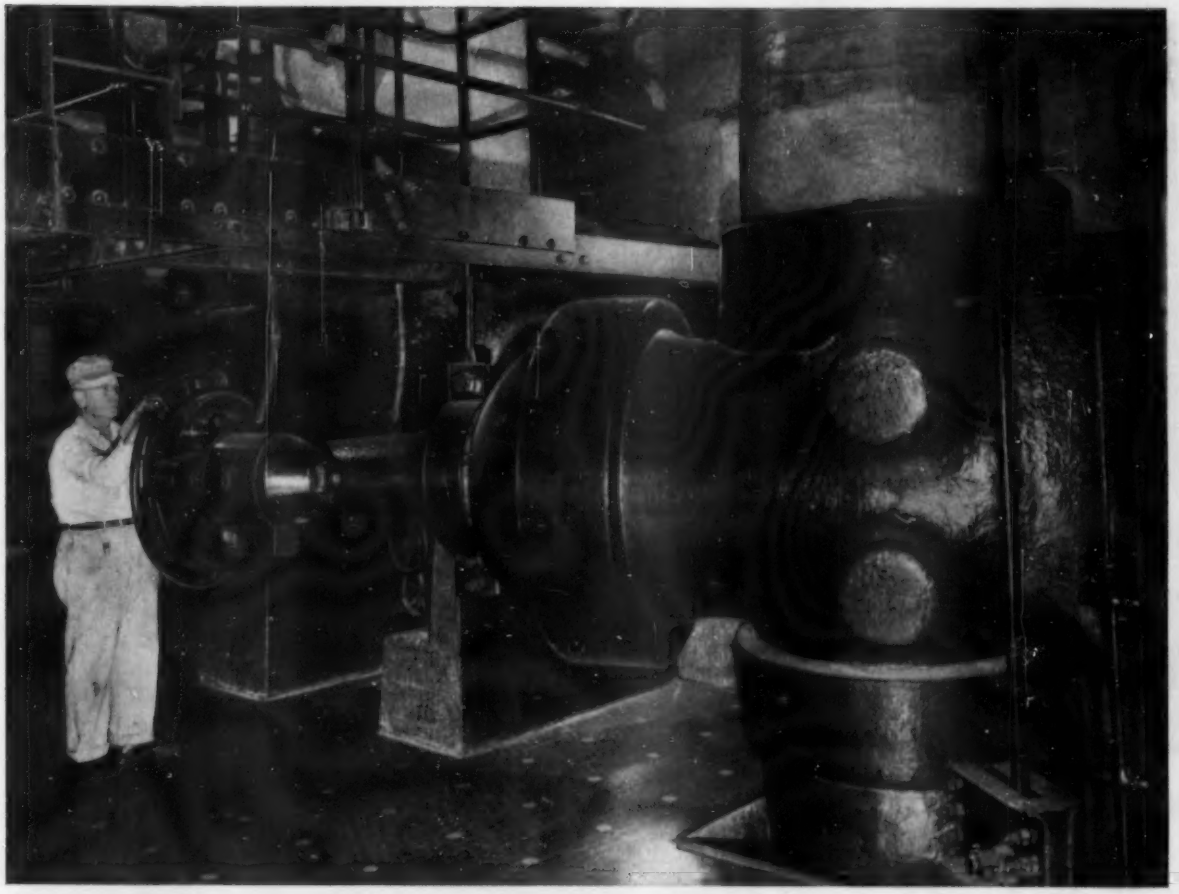
For more data on these items, use post cards p 167. Identify your request with item number.



Multiple-outlet header

1120 • This special-purpose fitting is said to simplify installation and effect a 70% saving in welding time required to complete by-pass, blowdown and branch connections to pipeline gate settings. Unit consists of a header with multiple seamless outlets in exact specified positions—plus a factory-fabricated conical reducer.

Installations have already been made on 24 and 30-in. lines, with one, two and three outlets per header ranging from 6 to 12



Dividends from this Crane valve over 30 years... 6¾ billion kilowatt-hours

Over thirty years ago, this 30-inch Crane steel gate valve was put in service at Commonwealth Edison's Crawford Station in Chicago.

As of May, 1955, unit No. 1 on which this motor-operated valve is installed, had been in operation more than 150,000 hours. Total power output generated with this valve in service was approximately 6,750,000,000 kilowatt-hours.

The valve is on reheat steam service with working conditions of 100 psi. at 700 degrees F. Never out of the line, and given but routine maintenance attention since installed in 1925, the valve's performance remains completely satisfactory.

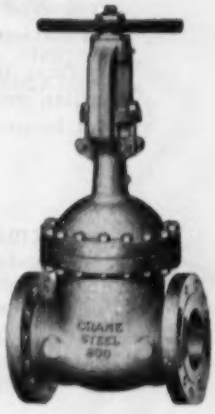
Seating action is positive and tight; bonnet-joint and stem seal are tight; operation is smooth.

There is nothing special about this rising stem, cast carbon steel valve—nothing but its dependable Crane quality. Development of steel valve castings was pioneered by Crane; long life and low maintenance are deeply rooted characteristics of Crane valves.

In steel valves, as in other materials, the Crane line is most complete: gates, globes, angles, checks and stop-checks—bolted, Pressure-Seal, and Lip-Seal bonnet designs—screwed, flanged, or welding ends—sizes up to 24 in.—pressure classes up to 2500 psi.

Your Crane Representative can give valuable help in specifying and ordering.

Crane Co., General Offices, Chicago 5, Ill. Branches and Wholesalers serving all industrial areas.



CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

POWER
SPECIALISTS!
KULJIAN HAS DESIGNED, ENGINEERED, AND SUPERVISED CONSTRUCTION OF POWER PLANTS THE WORLD OVER . . . WITH TOTAL ELECTRIC GENERATING CAPACITY EXCEEDING—
2,000,000 KILOWATTS!

Vast power projects throughout the world—more than seventy in all—attest to The Kuljian Corporation's reputation as SPECIALISTS IN THE POWER FIELD. These power plants, with capacities ranging from 2,500 to 240,000 KW, represent a total investment of over half a billion dollars.

No matter what type of power project you are planning . . . be it steam, hydro, or diesel . . . Kuljian's wealth of practical experience, backed by a complete staff of internationally recognized engineers, can serve you quickly, economically, and efficiently to meet your specific requirements.

Next time *you* need outside help, why not contact a Kuljian engineer for preliminary consultation. He will be glad to provide the help you need, anytime . . . anywhere.

ACTUAL ON-THE-JOB REPORTS are continually received at Kuljian headquarters. From these reports, easy to read case histories are developed into articles that are published by editors of leading magazines.

If you are interested in knowing more about us . . . how we work, what we have done for others . . . your request for literature will be most welcome.

The Kuljian *Corporation*

engineers • constructors

1200 North Broad Street • Philadelphia 21, Penna.

BRANCH OFFICES THROUGHOUT THE WORLD

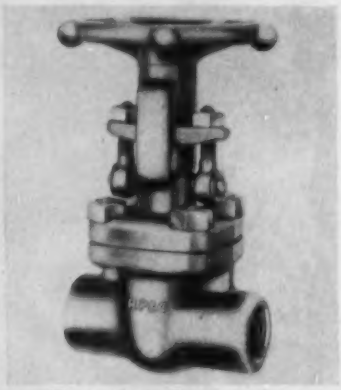
More EQUIPMENT NEWS

Begins on page 158

in. in diameter. The fittings can be produced in sizes through 42 in. pipe—and larger if required, virtually without restriction as to length of header section, number, size or arrangement of outlets or range of conical reducer sizes.

In addition to being used for valve settings on the main line, these headers are also being used as suction and discharge manifolds on compressors.

Ladish Co, Cudahy, Wis.



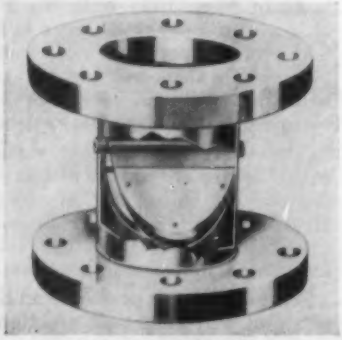
Forged-steel gate valves

1131 • Redesigned valves for the petrochemical, power and process-piping industries are available from ¼ to 2 in., with either screwed or welded ends.

Claimed improvements include stainless-steel eyebolts, nuts and follower; redesigned stuffing box and smoother operating stem that cannot damage packing during valve assembly. Stuffing-box packing consists of molded asbestos, wire reinforced and mica lubricated—reducing possibility of pitting of the stainless-steel stem.

R-P&C Valve Div, American Chain & Cable Co, Reading, Pa.

For more data on these items, use post cards p 167. Identify your request with item number.



Check valve for fluid lines

1124 • Unit works with maximum efficiency in high- or low-pressure gas, water, vapor, gasoline and other fluid lines, giving positive automatic closing and opening on low-pressure differential.

Simple construction does not use a valve seat—but employs valve body for that purpose. Unit permits straight-line flow and

HOFFMAN IMPROVED DESIGN VACUUM PUMPS

THROUGH 20,000 SQ. FT. E. D. R.

SINGLE AND DUPLEX UNITS—RATINGS THROUGH 20,000 SQ. FT. E.D.R.

- HOFFMAN FAMOUS JET VACUUM PRODUCER ASSURES GREATER EFFICIENCY—LOW UPKEEP.
- CUTS OPERATING TIME AND POWER BILLS APPROXIMATELY ½.
- ENGINEERED TO REMOVE UP TO 300% OF RATED CAPACITIES OF AIR AT START OF HEATING CYCLE.
- SHORTER WARM-UP PERIOD MEANS ECONOMIES.

COMPLETE LINE OF HEATING PUMPS

VACUUM PUMPS THROUGH 100,000 SQ. FT. E.D.R. including units individually sized with separately controlled vacuum and condensate pumps for specific application.

CONDENSATION PUMPS THROUGH 150,000 SQ. FT. E.D.R. Watchman Pump—a small compact unit for systems through 8,000 Sq. Ft. E.D.R. and 20# pressure.

CAST IRON RECEIVERS ON ALL HOFFMAN PUMPS.

HOFFMAN Steam Specialties—Hot Water Specialties—Radiation Controls—Blake Plumbing and Drainage Products.

HOFFMAN SPECIALTY MFG. CORP.
1700 West 10th Street Indianapolis 7, Indiana

REPLACEMENT TUBES
-not in weeks-but hours
any size... any boiler
You can get the tubes you need ... right now ... if you order your replacements from B.T.A.
Yes, you save time, save money, save headaches, because B.T.A. carries the most complete range of sizes ... in regular or heavy gauges ... for any make of boiler. No need for costly shut-downs ... just 'phone or wire!
for
BIGELOW ★
BADENHAUSEN ★
CASEY HEDGES ★
CONNELLY ★
COMBUSTION ★
COLLINS ★
EDGEMOOR ★
ERIE CITY ★
HEINE ★
FOSTER WHEELER ★
KIDWELL ★
KEELER ★
LADD ★
MAXIM ★
ROSS ★
RUST ★
SPRINGFIELD ★
STIRLING ★
TITUSVILLE ★
UNION IRON WORKS ★
VOGT ★
WICKS ★
and others
for any make of boiler
BOILER TUBE CO. OF AMERICA
McKEES ROCKS, (PITTSBURGH DISTRICT) Federal 1-7750
Philadelphia
Raphael Paul 328 Lafayette Bldg. Lombard 3-7700
Tampa
John D. Homan 14 South Orleans Ave. Tampa 8-3952
Los Angeles
Fred S. Renauld & Co. 1014 W. Eighty-Fourth St. Pleasant 2-6181
2

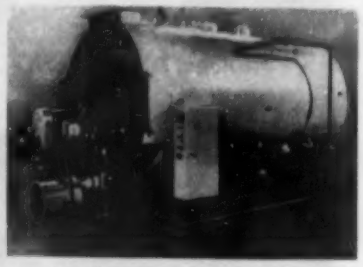
More EQUIPMENT NEWS

Begins on page 158

is silent. It may be built of any of a wide range of materials including steel, bronze, cast iron, aluminum.

Standard or custom designs with either automatic or manual locks are available. Valve sizes range to 36 in. Standard valves are built for pressures to 50 psi. Special units can be furnished for pressures to 400 psi. Full details on request.

Techno Corp, 16-30 W 5th St, Erie, Pennsylvania



Packaged boiler units

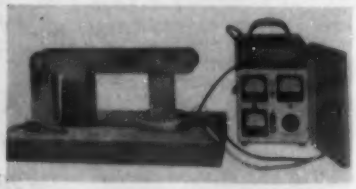
1129 • These boilers can be equipped with any established type of firing arrangements to suit individual conditions. Thus, user has advantage of selecting equipment best suited to his particular needs, though it is supplied as a complete unit.

Basic boiler is of two-pass design. A large steam space has been provided to reduce water entrainment, while turbulent gas travel ensures high thermal efficiency.

The boilers are suitable for oil, gas or combination oil-gas firing with either natural, forced or induced draft.

Dominion Bridge Co, Ltd, Lachine, P.Q., Canada

For more data on these items, use post cards p 167. Identify your request with item number.



Coil-testing instrument

1126 • Instrument is designed for testing field coils, armature coils, transformer coils, solenoids, etc. It detects shorts on one or more turns, detects opens and shows number of turns in a coil from 10 to over 3000.

Minimum coil opening is 2⅝ x 3 in. or 3⅞ in. diameter. Maximum coil height is 6 in. Unit operates on 115-v, 60-cycle ac current. Transformer base size is 12 x 24 in. Request complete details.

The Martindale Electric Co, 1385 Hird Ave, Cleveland, Ohio

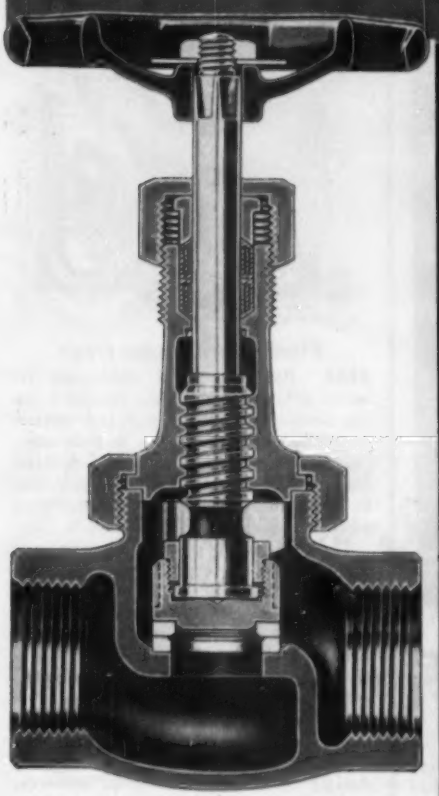
Heavy fuel oil additive

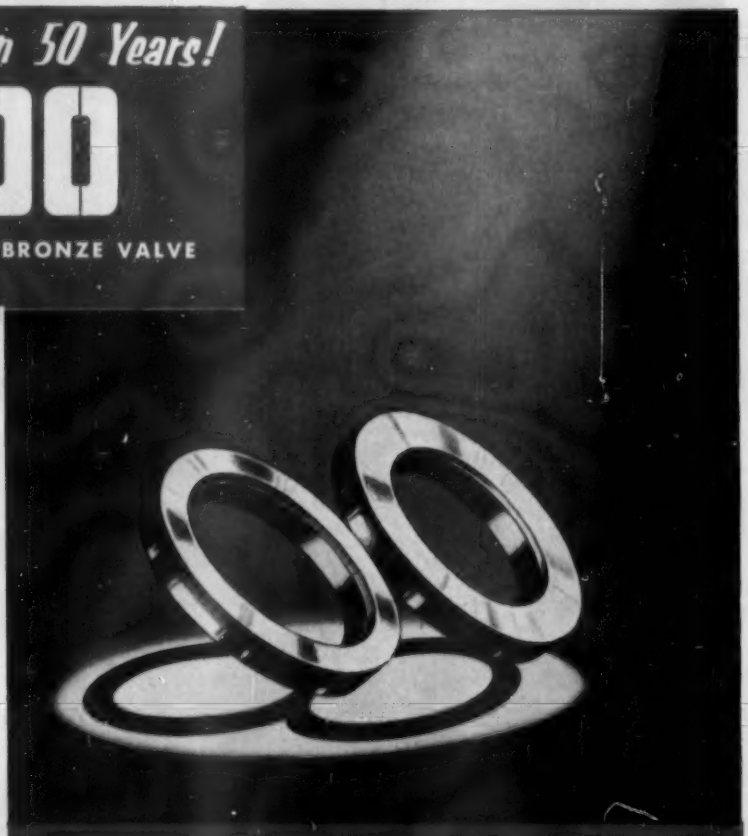
1121 • Additive for No. 4, 5 and 6 oil is non-corrosive and non-explosive and has a flash point of 206 F. Called *Desludgit*, it is designed to break up oil-water gels,

Biggest Valve News in 50 Years!

LQ600

THE REVOLUTIONARY NEW BRONZE VALVE





BRINALLOY

SEATS and DISCS

HERE'S THE BIGGEST BRONZE VALVE NEWS IN HALF A CENTURY—made possible by Brinalloy, a new patented seating alloy developed in the Lunkenheimer Metallurgical Research Laboratories. Seats and discs of this new alloy are far more resistant to wear and corrosion than 500 Brinell Stainless Steel — they even outwear case-hardened Stainless Steel exceeding 1000 Brinell! In the most severe tests, there was no need for renewability, repair, or replacement.

LUNKENHEIMER

QUALITY

NOW you can beat the high cost of valve maintenance and replacement with the first completely revolutionary bronze valve in 50 years! No matter how severe the throttling service, in 4-year tests, there was no leakage, erosion, or wire drawing. This new valve pays cash dividends in maintenance savings — *year after year after year!* For more information, call your Lunkenheimer Distributor or write The Lunkenheimer Company, Box 360, Cincinnati 14, Ohio.

* *Patented Alloy*

BRONZE • IRON • STEEL • PVC

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

PRACTICE PREVENTIVE MAINTENANCE

WITH R/M's BIG 7 PACKING TYPES

No longer do you have to settle for costly, time-consuming corrective maintenance measures. You now can do as thousands of other plants have done: *set up a schedule of preventive practice* with R/M's Big 7 Packing Types. Their custom-built construction will provide you with superlative replacement performance—except in the very rarest applications. Most plants have found that they need only three or four to meet all their needs. By standardizing on them, they have reduced downtime, cut costs, lowered inventories, and simplified ordering. To find out how you can do the same, ask your R/M distributor for the R/M Big 7 Recommendation Chart.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M Packings for maintenance purposes are sold only through authorized R/M distributors

R/M BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.

PACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

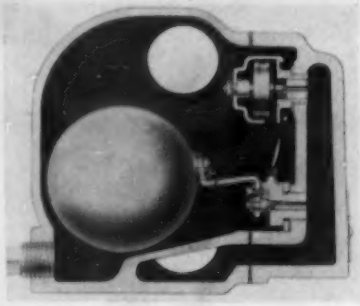
RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

More EQUIPMENT NEWS

Begins on page 158

dissolve sludge and emulsify water in the oil. Claimed result: fuel system remains clean from fuel tank to chimney because all oil is consumed at peak atomization efficiency. Further details on request.

Stewart-Hall Chemical Corp,
PO Box 66 L, Fleetwood,
Mount Vernon, N. Y.



Float, thermostatic traps

1132 • Rapid air and condensate removal in low-pressure steam systems is the big advantage of these float and thermostatic traps, according to manufacturer. Such action is said to make possible fast heating and efficient operation at pressures to 15 psi and prevent trap and connecting piping from becoming air-bound.

The traps' dual-operating functions are performed by an expanding thermal element and ball-float mechanism. At low temperatures thermal element is contracted permitting unrestricted removal of air to the outlet side. As temperature increases, thermal element expands and closes outlet, sealing trap against escape of steam.

Ball-float mechanism is designed to keep outlet valve closed until condensate level reaches a predetermined height. As condensate level rises, ball floats upwards, outlet valve is opened and condensate flows from trap.

Connecting pipe sizes range from ¾ to 2 in. Capacities range from 70 to 5750 lb of water per hour depending on pressure differential and connecting pipe sizes.

Strong, Carlisle & Hammond Co,
1392 W 3rd St, Cleveland, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.

Screwed-bonnet globe valve

1116 • This globe valve is especially designed and recommended for use on liquid-immersed electrical transformers. It is available in ¾, 1, 1½ and 2 in. sizes and is rated for 150 lb maximum pressure at 200 F maximum temperature.

The valve has a screwed bonnet, integral semi-crown seat, spun-on connection between stem and disk holder, and a synthetic-base composition disk that is highly efficient in transformer oil service. A boss on the outlet side can be tapped for insertion of a ⅜ in. vent valve.

Crane Co, 836 S Michigan Ave,
Chicago 5, Ill.

New Money-Saving Airpower Anywhere in the Plant

Compact... Lightweight... Air Cooled

Le Roi Stationary Compressors are easily installed... anywhere

Take full advantage of every space in your plant where the economies of airpower can increase production and lower costs. How? By using Le Roi's two-stage, air-cooled stationary compressors that require a minimum of space, and are easy to install.

They're compact and lightweight. Moreover, these Le Roi compressors require no cooling water, eliminating the need for expensive space-eating pipes. There's no danger of freeze-ups or overheating from lack of liquid coolants. Only minimum attention by an operator is needed.

The new three cylinder 50S2, and six cylinder 75S2 and 100S2 compressors are balance-designed, reducing vibration and noise to a minimum. Available in 50, 75, and 100-hp sizes producing 210, 340, and 450-cfm capacities at 125 lbs. pressure, these new Le Roi airpower units offer low-cost operation, low-cost installation, and low-cost maintenance advantages for a wide range of needs.

For years Westinghouse compressors were the national favorite in the ½ to 40-hp size range. With the three new Le Roi sizes, an even greater range of dependable airpower is yours — up to 100 hp.

Write today for complete literature describing Le Roi's dependable, low-cost air supply.

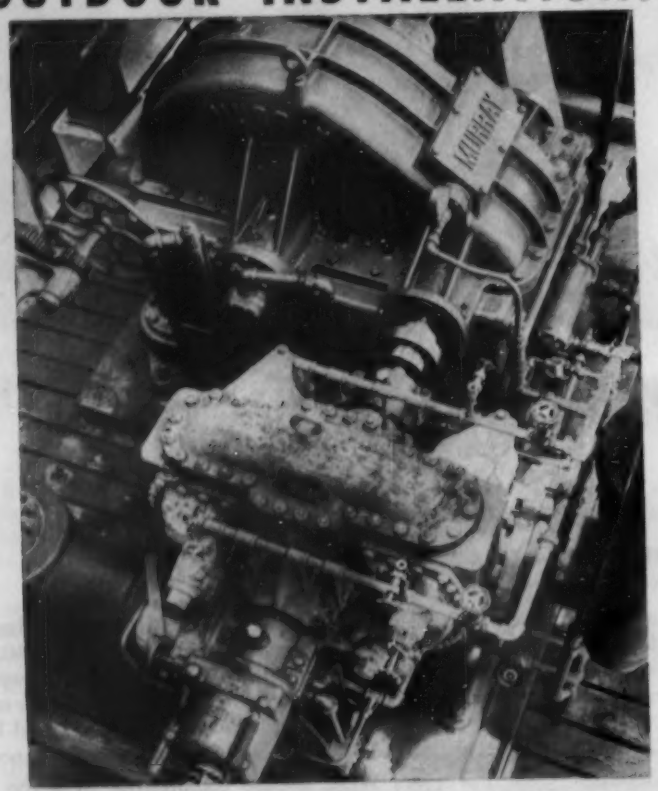
LE ROI Division of Westinghouse Air Brake Co.

MILWAUKEE 14, WISCONSIN

Distributors in all principal cities

Murray Turbines

OUTDOOR INSTALLATION?



THE RIGHT ANSWER—MURRAY

The turbo-gear unit shown above has been installed outdoors with virtually no weather protection for many years. The turbine exhausts to a process line carrying 170 psig pressure.

Yes — for rugged applications — the right answer — MURRAY.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

BOOKSHELF

I. Research Reactors; II. Reactor Handbook: Physics; III. Reactor Handbook: Engineering; IV. Reactor Handbook: Materials; V. Neutron Cross Sections; VI. Chemical Processing and Equipment. *Six volumes prepared by the U.S. Atomic Energy Commission. Total pages 3591, illust. $62.00 set, may be purchased separately. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

A major step forward in The Atomic Age was made in August, 1955. What was until then secret information was released to the world by the U.S. Atomic Energy Commission at the first international "Atoms for Peace" conference in Geneva, Switzerland. Now much of this helpful material can be procured for private research and industrial organizations through these six volumes.

The books provide a practical basic source of technical information on nuclear energy and its beneficial applications. Material covered ranges from descriptions of research reactors now in use to a catalog of special laboratory equipment, and includes a three-volume handbook on reactor physics, technology and materials. It shows much concerning the ways in which fissionable materials can be put to work in nuclear reactors for research purposes and for production of power and radioisotopes. Following is a brief description of each of the volumes:

Research Reactors. *406 pp, 7⅞x10¼, illust, $6.50.* Detailed descriptions, complete with selected design drawings, of six types of U.S. research reactors now in use.

Reactor Handbook: Physics. *804 pp, 7⅞x10¼, illust, $12.00.* Discussion of reactor physics and nuclear-design data, including shielding theory and calculating techniques.

Reactor Handbook: Engineering. *1088 pp, 7⅞x10¼, illust, $15.00.* Review of reactor technology, including basic reactor systems applicable to power development and a summary of experimental reactor designs.

Reactor Handbook: Materials. *614 pp, 7⅞x10¼, illust, $10.50.* Data and background information on reactor materials; fuels and moderators, and shielding, structural and miscellaneous materials.

Neutron Cross Sections. *363 pp, 15¾x10¼, illust, $12.00.* Recent compilations of neutron cross-section data affecting reactor design.

Chemical Processing and Equipment. *316 pp, 7⅞x10¼, illust, $6.00.* Process and engineering description of a separation system, together with a catalog of special equipment used in the handling of radioactive materials.

Techniques of Plant Maintenance and Engineering 1955. *218 pp, 8½x11, illust, cloth, $7.50. Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.*

This book is a compilation of the proceeding of the technical sessions held concurrently with the Sixth National Plant Maintenance and Engineering Show in Chi-

These are Zallea Pressure-Balanced Expansion Joints. They provide a sound engineering solution to the problem of absorbing pressure thrust where a change in direction occurs, and it is not possible to anchor the elbow.

Their operation is simple. Both expansion joints shown are designed to absorb axial and lateral movement in the inboard bellows. By means of tie rod action, the pressure thrust of the inboard bellows is balanced by the countermovement of the outboard bellows. This design is frequently used in piping connections to a turbine to eliminate the pressure thrust against the turbine casing. Many other applications may occur to the design engineer.

An original Zallea design, these specialized joints are another example of our ability to develop, engineer and manufacture expansion joints to meet your specific needs. For information on standard types, or help with special expansion or piping problems, call in a Zallea representative.

Zallea *expansion joints*

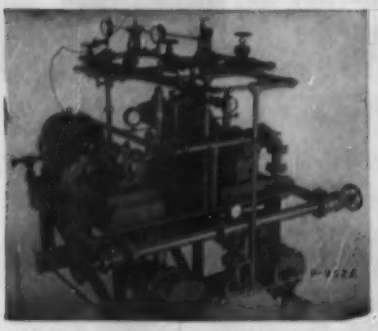
ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . more compact than ever! Write for Bulletin 40.

NATIONAL AIROIL
COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

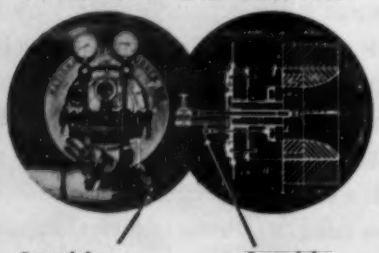
IGNITION PORT

FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER

These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL
UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1230 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More BOOKSHELF

Begins on page 182

cago. Included are the papers that were presented at the conference, the stenotypist's transcript of the discussions that followed them and reports of the round-table sessions at which specialized phases of the maintenance function were given intensive consideration.

Topics at the general sessions and sectional conferences, covered in this works, were those of greatest importance and interest to plant engineers in today's industrial plants.

Handbook of Engineering Materials. *Edited by Douglas Miner, Carnegie Institute of Technology, and John B Seastone, Olin Mathieson Chemical Co. 1382 pp, $17.50. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

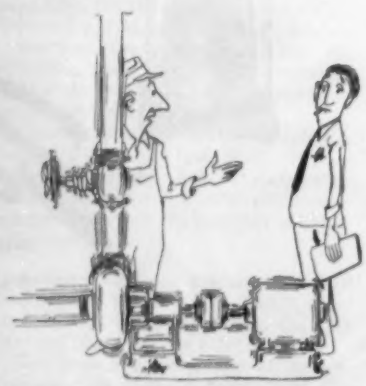
Centralized identification and working comparison of manufacturing and construction materials are presented in this book. Technical properties take precedence, with emphasis on selection and use of material, and major attention is directed to adaptability to fabricating methods, availability, costs and limitations.

Arranged by classes of related materials, the book first provides general information on specifications and standards, statistics in application of materials and mathematical and physical tables.

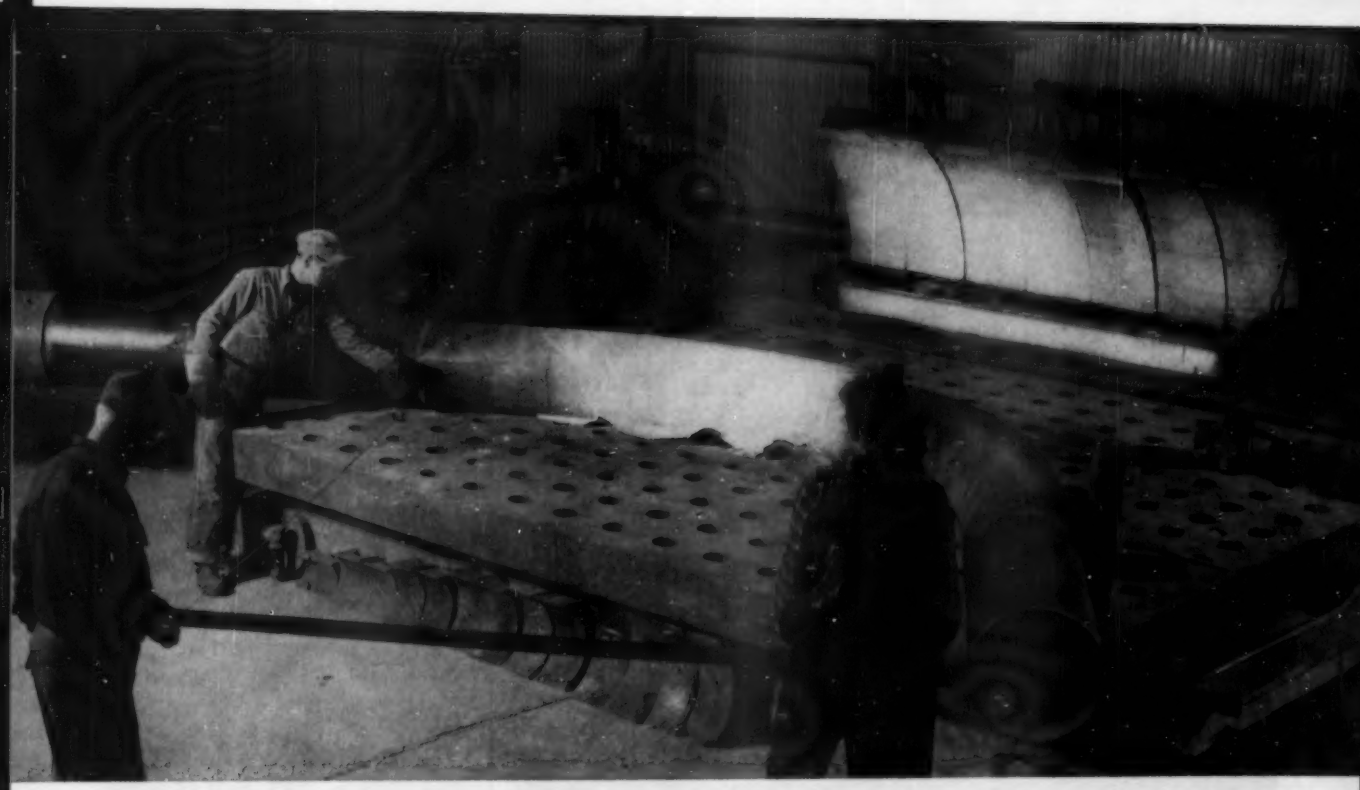
Second section is devoted to metals and includes ferrous metals, aluminum, magnesium, copper and its alloys, zinc, nickel and its alloys, other pure metals and special-purpose metals and alloys.

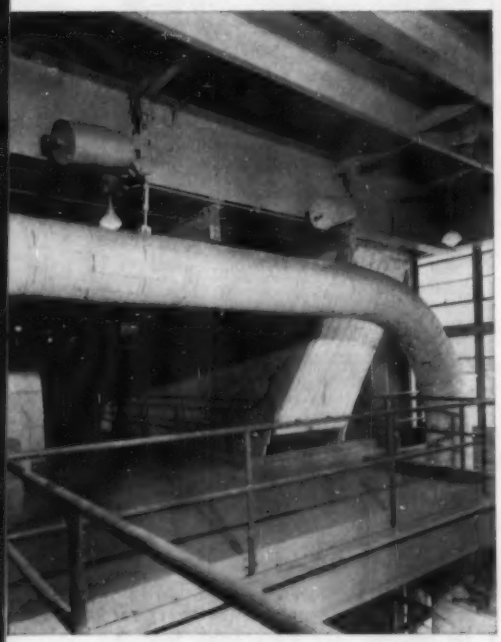
Details for non-metals are given in the third section. Wood and wood-base materials, paper, fibers, plastics and rubbers, organic finishing materials, fuels, carbon products, ceramic materials, industrial chemicals and lubricants are individually treated.

Construction materials are covered in the final section, with analysis directed to cementing materials and concretes, roadbed materials, timber, rope, foundations, weather and moisture protection and glass products.



"What do you mean it doesn't *look* right? I aligned it myself."





This station, having an initial capability of 276,000 kw, was designed and erection supervised by Gilbert Associates, Inc., Reading, Pennsylvania. It is one of the most efficient and low-cost stations in the country.

At the new Shawville Station of Pennsylvania Electric Co.

it's NAVCO Piping throughout

Over 37 miles of pipe were installed by Navco in this highly efficient reheat station and all necessary prefabricated assemblies, in excess of 2,000,000 lbs., were produced in Navco shops. For field welding only, more than 15 tons of electrodes were used.

The photo above shows one of the bends required for the Main Steam. It is 16″ O.D. forged and bored with a wall thickness of 3.084″ and weighs 5½ tons. Material is ASTM A-335 P-22—2¼% Chrome. Operating conditions are 1850 psi at 1050°F. initial, with 1000°F. reheat.

The photo at the left shows this bend in service supported by dependable Navco Counterpoise Hangers.

In the past three years alone, Navco Piping has been installed in Central Stations generating in excess of 4,000,000 kw.

Next time you have a Piping job requiring reliability in performance and careful attention to every small detail, Navco will welcome the opportunity of quoting you.

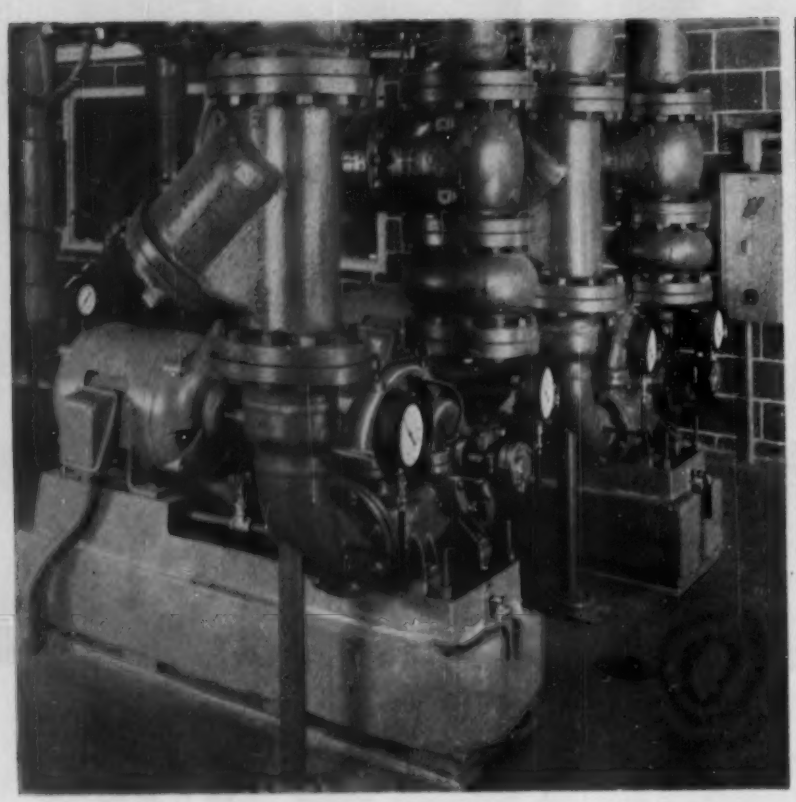
Call, wire or write today!

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati



WILL THE PUMPS MATCH THE EXCELLENCE OF YOUR INSTALLATION?

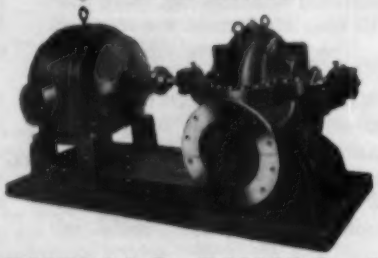
The wrong pump can spoil the most perfectly planned job — the right one helps make it a lasting success! "Buffalo" Pumps like the Double Suction Type SL below (for clear water service) have earned the reputation for reliable performance over and over. The "Buffalo" Q Factor—*the built-in Quality which provides trouble-free satisfaction and long life* — goes into every "Buffalo" Pump you specify.

WHY TAKE A CHANCE? PICK "Buffalo"

THE PUMPS PROVEN BY 78 YEARS OF SATISFACTION.

YOUR "BUFFALO" REPRESENTATIVE

is ready with competent help in selecting the right pump for any problem you may have. Graduate Engineers, factory and field trained. In all principal cities. Call on your nearest one!



"Buffalo" PUMPS

BUFFALO PUMPS, INC.

488 BROADWAY, BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

MARMADUKE

Continued from page 146

tor tried every trick in his bag, but nothing worked. He was a good turbine man but had one failing. He wouldn't take advice from anyone who wasn't a manufacturer's specialist like himself.

"All turbine and generator rotors had been balanced statically and dynamically before shipping from our plant. But every erection man knows that a stator balanced while being built isn't always balanced when installed on the job and hooked up with another unit.

"First thing the erector did was to disconnect the electric end and run the steam end by itself. She ran fine within normal speed range, no vibration. But after he hooked up the generator again, brought her up to speed and threw on the load, she vibrated as badly as before.

"His next brainstorm was to balance both ends without removing the casing cover. First, he disconnected the steam end from the electric end. Inspection plates in turbine casing were removed. Then, rotor-balancing plug was shifted, one hole at a time and rotor revolved to see if it would stop in a different position. That was a big job on a turbine of her size, and working through inspection ports wasn't easy. After a few weeks of balancing—still no dice.

"By then our firm got worried and replaced the erector with another man. In the next two years before I was sent to that job, eight erectors tried their hand, but the turbine still vibrated.

"One man said the bearing clearances weren't right. He played around with the bearings for a few weeks. When that didn't help he was replaced with another erector. Next guy said the turbine wasn't aligned properly. So he realigned the machine but the vibration stayed. The power plant's maintenance crew worked with all our erectors during those two years.

"His successor checked the machine and said there wasn't enough clearance on the low-pressure bladings. The turbine was opened up and the heavy rotor removed. The low-pressure blading was attached to a steel hub that was shrunk on the shaft. This hub's inside diameter was four feet. It had to be heated with torches and then slipped off the shaft. That was a major operation.

"After the bladed hub was off, the maintenance boys got busy and scraped a total of 0.015 of an inch from the hub's ID. Scraping the inside of that steel hub by hand was one hell of a job. It took a few months, but finally

Georgia Power Company looks ahead—

selects GULFCREST OIL for long range protection

Georgia Power Company's Yates Plant at Newnan, Georgia, has three 100,000 KW General Electric Turbines in operation and is adding a fourth, which will be a 125,000 KW unit. 3,450 gallons of Gulfcrest Oil in each of the lubrication systems provide safe, sure, long-lasting protection.

Gulfcrest Oil has been in service at the Yates Plant of Georgia Power since 1950. Turbine systems are clean, there is no rust, sludge, or foam. But this is only the beginning. Gulfcrest will provide safe, sure protection for many years to come. (Gulfcrest has been in continuous service in several large turbines for over 20 years.)

There are good reasons for Gulfcrest's recognition as the world's finest turbine oil. Carefully selected crude oils are thoroughly refined, then super-refined by Gulf's exclusive Alchlor Process. This removes the unstable hydrocarbons that accelerate oxidation, form sludge and harmful acids. Then the right additives are properly combined, and you have a turbine oil that delivers superior performance in every type of steam turbo-generator.

A trained, experienced lubrication expert—the Gulf Sales Engineer—is as near as your telephone. Have him recommend the right grade of Gulfcrest for your turbines. Consult the telephone directory for the number of your local Gulf office.

GULF

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

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NEW PACKING DEVELOPED BY CHESTERTON FOR

sulphuric acid

Sulphuric Acid, Nitric, Hydrocloric, in fact on any Acid* Blu-Lon, Chesterton Style 320, makes a tight lasting seal. Blu-Lon is braided from chemically pure African Blue Asbestos and through a specially designed method each single strand is immunized and lubricated with DuPont Teflon. This process is not to be confused with other quick dip Teflon treatments as Blu-Lon is a thoroughly impregnated Teflon packing. This added protection plus Blu-Lon's unique breaking-in lubrication places this packing in an Acid resisting field by itself.

Chesterton Blu-Lon is recommended for strong acids of 1–4 pH value. Note chart below which recommends three Chesterton Packings for full range of chemicals 1–14 pH.

Blu-Lon comes thoroughly lubricated, *ungraphited*, blue in color. It is ideally suited for service on chrome plated or stainless steel shafts.

** For Hydrofluoric Acid write us for special recommendation.*

A pH SCALE FOR CHEMICAL PACKINGS

1 TO 4	5 TO 10	11 TO 14
pH VALUES	pH VALUES	pH VALUES
STRONG ACIDS	WEAK ACIDS OR ALKALIES	STRONG ALKALIES
#320	#315	#322
Blu-Lon	Carsons	White-Lon

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

MARMADUKE

Continued from page 186

it was done. The hub was heated again and slipped back on the shaft to shrink on as she cooled. Because of the metal removed from hub's inside, the blading was pulled farther away from the casing and did have a little more clearance. But after the turbine was put together and started, she went into her same old St. Vitus dance.

"That erector left and another took his place. In the meantime, the coal company was raising merry hell because they needed the turbine. But the turbine builders were just as sore because they hadn't been paid for the machinery and were spending barrels of money on it besides.

"The next erector arrived and found some cracks in the foundation at the turbine end. He had the concrete torn out, along with its reinforcing steel. The cracks turned out to be superficial, but that didn't stop him. When the new foundation did no good, he looked around and decided that the cracks in the foundation under the electric end were the cause. Out came that foundation, in went a new one. Two months later the machine was again started, but again she shimmied. After a few more erectors showed up and left, I was put on the job.

"On arriving, I wanted to find the smartest man in the plant, the guy who knew the most about that turbine and about everything the other erectors had done. He turned out to be the Chief Engineer. He was a swell guy and gave me the whole story.

" 'You know, Mr Surfaceblow,' he said, 'my boys have taken this machine apart so often they can remove all those big bolts and take that giant cover off and put it back in one day. I'll bet a stable of chorus girls aren't better trained to go into their act than my boys.'

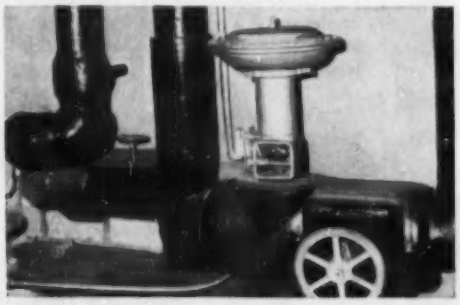
"I spent the first few days looking around, talking to everyone, but I didn't take anything apart. I had the Chief tell me what each erector's theory had been. I believe in cashing in on the other guy's experience before cracking my head against a stone wall.

"The Chief was a topnotch engineer —I could see that. But I felt he was holding something back. During lunch on the second day I opened up on him. 'Chief,' I said, 'I've got reason to think you know more about this turbine than all those eight erectors put together. Before I try anything, I want to know what your theory is.'

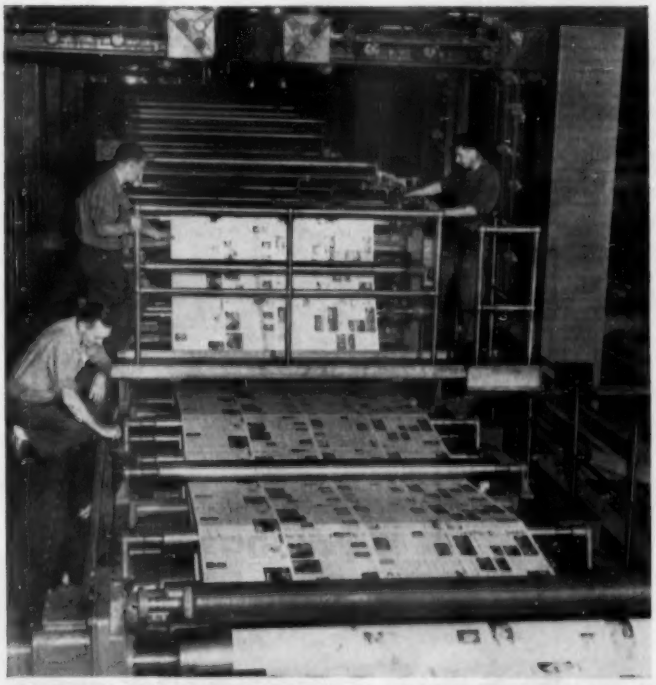
" 'You don't want my advice,' he answered. 'You manufacturers' men are experts and you know all the answers.'

" 'What makes you say that?' I asked.

Rotogravure Building, Triangle Publications, Inc., Philadelphia. Albert Kahn Associated Architects & Engineers, architects and engineers, Detroit; Eggly-Furlow Engineers, mechanical engineers, Philadelphia.

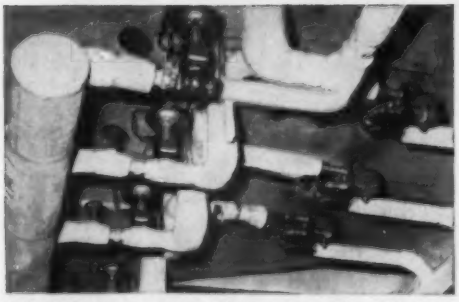


AIR CONDITIONING. A Johnson 3-Way Mixing Valve, with Pilot Positioner, gives precision control of chilled water supply to a unit serving a processing area.

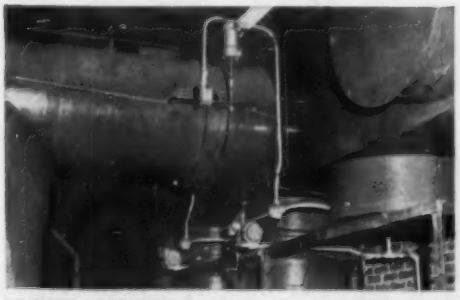


HEATING and VENTILATING. Strategically located Johnson Thermostats regulate heating and ventilating systems for huge press rooms housing 61 giant, high speed press units. Johnson Humidostats closely control relative humidity also.

INTRICATE CONTROL PROBLEMS CORRECTLY SOLVED by JOHNSON



REHEAT COILS are controlled by Johnson Steam Valves in response to demands from Room Thermostats. Pilot Positioners provide maximum, accurate repositioning power.



SOLVENT RECOVERY SYSTEM receives vapor-laden air at rate of 1500 cfm from each press unit. Johnson Static Pressure Regulators and Damper Operators help insure safe air movement through enormous duct system.

Triangle Publications' impressive Rotogravure Building is one of the largest and best equipped gravure plants in the world.

Dependable control of temperatures and humidities is essential in an operation this size. Processing requirements, product protection, worker comfort, safety and operating costs are among the complex factors which must be resolved correctly.

A Johnson-engineered Control System, in command of 25 central heating, ventilating and air conditioning systems, solves all of these problems with precision, satisfying the exact needs of such diversified spaces as press rooms, paper storage, etching and developing rooms, private and general offices and cafeteria.

In addition, other Johnson controllers are applied to the solvent recovery, waste paper pneumatic conveyor, paper handling, ink handling and exhaust systems.

How about your control problems? Whether they involve a simple application of one or a few controllers, or the installation of an intricate temperature, humidity or process control *system*, look to Johnson for the correct answer. An engineer from a nearby Johnson branch will gladly give you his recommendations without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL

TEMPERATURE ⇅ AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

if

you have any of these troubles:

- scale, corrosion, or foaming in your **boiler operation**
- rust and corrosion in your **steam and condensate return lines**
- scale, corrosion, or algae growth in your **cooling or condenser water system**
- corrosion or scale in your **hot or cold water tank and lines**
- rust and corrosion in your **brine or sweet water system**
- scaled up **pumps, water jackets, compressors, coils, lines, or equipment**
- sludge and moisture in your **fuel oil supply**
- soot deposits in your **furnace combustion areas**

then . . .

let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam, and fuel. Mail the coupon today for full information.

65 Years Experience in the Chemical Treatment of Water.

Chemical Treatment for Water Steam and Fuel

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MAIL THIS COUPON TODAY

My problem is _____

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MARMADUKE

Continued from page 188

surprised at his attitude.

"'Because,' he said, 'two months after the first erector ran into a blind wall I tried to tell him what I thought was wrong. His answer was for me to mind my own business. "If I don't know what's wrong and I'm a turbine expert," he yelled, "what in hell do you local engineers think you know about our turbines? Why you never even saw a turbine being built." So right then I decided to keep my ideas to myself.'

"'Look, Chief,' I answered. 'I've had firemen and oilers come up with smart answers. You tell me what you think is wrong. If it sounds like a shipshape idea, I'll go along with it.'

"'OK,' he answered, 'I came down here nights while that first erector was at his hotel. I'd start the turbine and do some experimenting to find the trouble. These copper expansion joints didn't seem to have any give. To prove it, I checked them with a dial indicator and inside mikes before warming up and while the turbine was hot and running. Those joints didn't show enough movement to talk about. That's what I was going to tell that first erector. There's plenty of expansion on 35 feet of metal between this turbine and the condenser's base. But if the joints don't give, I figure the machine is thrown out of line when she's up to running heat.

"'By golly, Chief, you've got something there,' I answered, slapping him on his back. 'I called my firm's design engineer long distance and asked him if he was sure they sent the right expansion joints with this job. After a few hours of checking he called back and said they had made expansion joints of the same diameter and length for another job when building this one. But those joints were much lighter. He said we had the wrong joints.

"I shoved off to another job in Texas and came back a month later when the new expansion joints arrived. After replacing the old ones, the vibration was gone. And that turbine passed her test with flying colors."

At this point, Marmy looked straight at me and waved his huge fist under my nose as if I was the cause of that vibration. He roared, "But buckets of money were burned up for two years because one so-called expert was too damn thick to listen to a man who wasn't a specialist like himself."—*SME*

For Marmy's Mailbox, see page 192

Built for
Severe Service
All O-B Gate Valves feature
the self-adjusting Flexitite Disc®.
Its unusual design combines advantages
of both the solid-wedge disc and
the two-piece disc. Order O-B gates from
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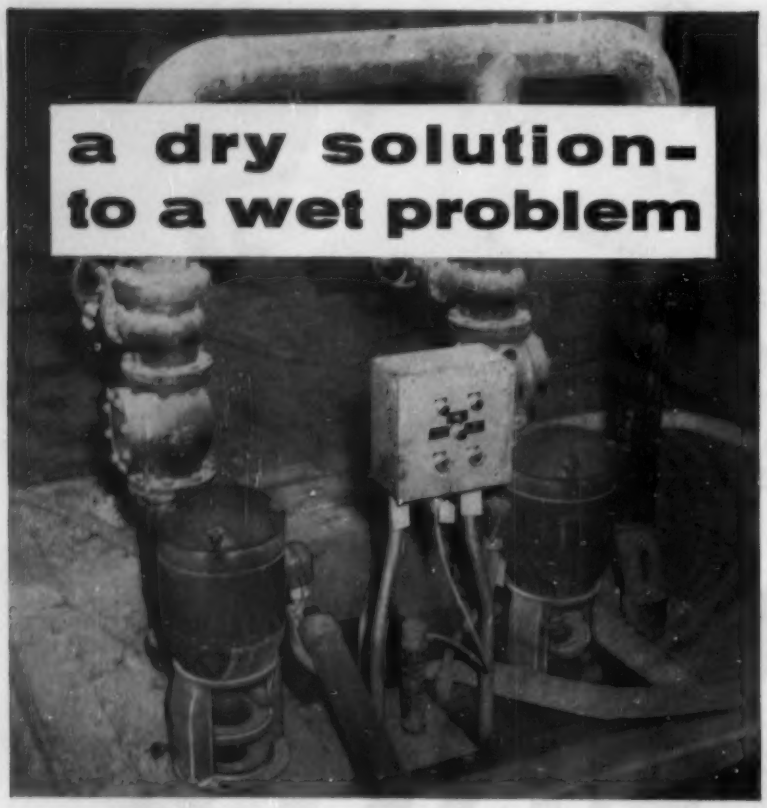
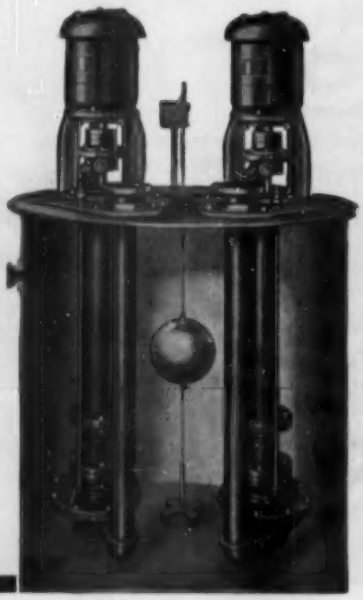


A large-volume user of water had a "wet plant problem." The solution is pictured above. Here you see two Deming Vertical Sump Pumps each with a 10 HP motor. Each pump has a rated capacity of 500 GPM with a 50-foot head. Unwanted water from all areas of the plant drains into a pit. When water in the pit rises to a predetermined level, one of the Deming Sump Pumps goes into action automatically. Or, if required, both pumps can be used simultaneously. If you have a "wet plant problem" there's a Deming Distributor near you to help you solve it.

DUPLEX UNITS

Where conditions require two pumps to operate separately, in sequence, or simultaneously, Deming Vertical Sump Pumps can be furnished as Duplex Units. The complete line includes a wide range of single and duplex units to meet most sump pump requirements. Write for illustrated BULLETIN 4600-A.

THE DEMING COMPANY
547 BROADWAY • SALEM, OHIO



Marmy's Mailbox

'Tis here you exchange blasts with the old boy

KNOWS HIS STUFF

"Tall chimney but no draft" in May issue gave me a kick. I know a man who had the same problem. His heating plant had a down-draft boiler with smoke pipe connected to a 40-foot brick stack. That made a very effective trap.

Plant stood dead all one summer when the weather was humid. That fall, he started with a good bed of kindling, then anthracite coal. Well, smoke came pouring out the fire door, refused to go up the stack.

Contractor called me. I tried building a fire in the stack's base. But not even a newspaper would burn for lack of oxygen. I then set a fan in front of the open fire door. Thus, I built up pressure in the fire box to push some warm air into the stack. That finally did the trick. Marmy knows his stuff.

Cincinnati, Ohio — I A BUTCHER

IN ENGINEERING LIBRARY

I have followed Marmy and his adventures for many years. POWER has been a part of my engineering library for years and I always enjoy the old consulting engineer's stories.

New York, N. Y. — F L PHILLIPS

KEEP BATTING AWAY

Received a copy of the Marmy book for Christmas and some of his stories are very amusing. Hope the old boy keeps batting away for years to come.

Granite City, Ill. — J DOROGHAZI

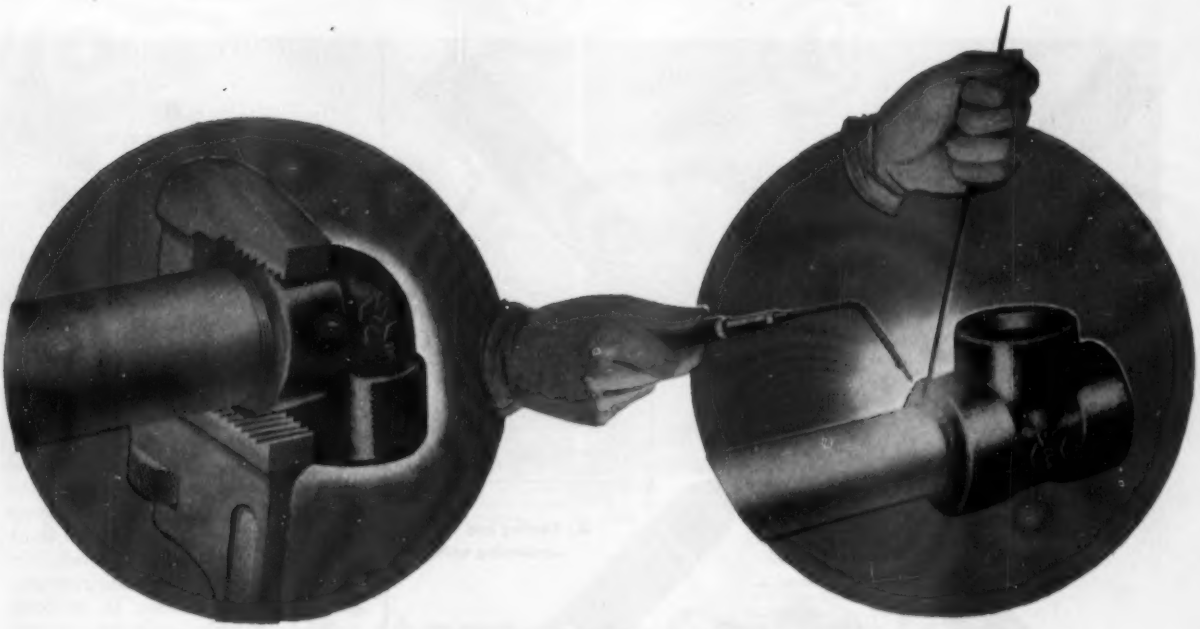
BILGEWATER ON A NEW POT!

How come Marmaduke never tells about his experiences with Ericsson Hot Air Engines? On those old babies when the fire pot burned through there was only one answer: Get a new fire pot. So all operators kept a spare on hand.

But one winter in 1903 our pot burned out and we had no spare. I'll bet Marmy could have got it going. I can hear him now, "Bilgewater on a new fire pot."

Hammond, Ind. — A D THERRIEN

SME's NOTE: We'll drop into the Bent Propeller one of these days and see what the old boy thinks about hot-air engines. Have any of you readers operated one? I know I never did—don't even know what they look like.



INSTALL WATSON-STILLMAN FORGED STEEL FITTINGS . . .

. . . and get THESE IMPORTANT ADVANTAGES:

- Resistance to Pressure, Heat and Corrosion
- Long Service Life
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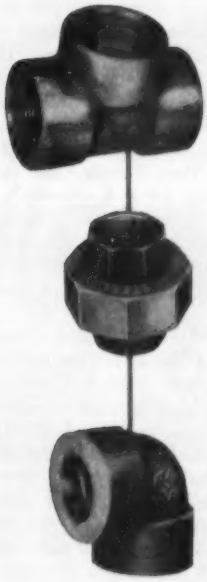

Watson-Stillman Forged Steel Pipe Fittings are fabricated and designed for tough service...and long service. They're drop forged of high quality metal to produce a strong, tough, fiber structure that resists the stresses of high pressures, shock and vibration. And our forged stainless and alloy steel fittings give you the added advantages of resistance to high temperatures and corrosion. Watson-Stillman Fittings assure you of safe, reliable service in process lines, high pressure steam lines and other arteries of the operating equipment in your plant.

You can obtain a complete line of W-S fittings to suit your service and fabrication requirements. Available in Screw-End and Socket-Welding Types in Carbon Steel, 1¼% Chrome-½% Moly steel, 2¼% Chrome-1% Moly steel, Types 304, 316 and 347 stainless steel and Monel.

Send today for our informative bulletins.

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WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, N. J.

AEROMASTER FANS

First choice for all four

Ask the manufacturer . . . *ask the user* . . . what fan he prefers for his cooling equipment. Chances are he'll say Aeromaster.

Why? Because he knows from experience that Aeromaster Fans can be relied upon to give good service.

Aeromaster Fans are *precision-engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. When you consider new equipment, call on Koppers . . . always eager to be of service.

KOPPERS

Aeromaster Fans

METAL PRODUCTS DIV. • KOPPERS COMPANY, INC. • BALTIMORE, MD. • This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators and Gas Apparatus. Engineered Products Sold with Service

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., Aeromaster Fans, 361 Scott St., Baltimore 3, Md.

Gentlemen: Please send me detailed information on Aeromaster Fans for .....(name and type of equipment to be cooled).

Name.....

Title.....Company.....

Address.....

City.....Zone.....State.....

ARGUMENTS

Continued from page 140

is forced-draft fired by mixing air with gas before it passes into the 600-cu-ft combustion chamber. Draft fan with damper open can supply 5000 cfm of air, operating against 2½-in. static pressure. Boiler has two burners, but normally only one operates. Each burner can supply about 200 cfm of gas, with 8-oz pressure at the burner.

Gorrie suggests the explosion could have resulted from stagnation of updraft, caused by dissipation of furnace, breeching and stack temperature during the night shutdown. Cool, damp air prevented gas from escaping, he says.

This theory might be true and possible with atmospherically operated burners. But the burners are power operated with forced draft. So I think such stagnation would not prevail. Nor would there be a fringe of concentrated gas within the furnace to suddenly ignite with resulting explosion, especially after the preignition purge.

Here's what I think happened, and how it should be remedied. Burners had been lighted off by gas torch, which is not conducive to safe procedure. The danger of explosion because of flame failure and relighting is ever present in oil or gas firing. Accordingly, when flame fails, instantaneous and positive shutdown is vital. Even a few seconds' delay between the failure of flame and cutting off the fuel may be dangerous.

To safeguard against such conditions, burner system should be incorporated with automatic gas-electric ignition pilot to light-off burner. The system should shut down before main fuel valve opens if the pilot flame has not lit. After establishing main flame, the flame-failure safeguard should close pilot valve. Then if main flame fails or even goes out for a few seconds, the safeguard system should immediately close the main fuel valve and sound an alarm. Automatic startup and shutdown programming should be a part of this safety equipment.

The flame safeguard should not permit gas flow to the main burner unless satisfactory ignition is assured. And a man should be able to open the main burner safety shutoff valve manually only when it is energized through the flame safeguard circuit. It should not be possible to block the safeguard circuit open. There should be a purge cycle lasting a definite time before light-off and means to prevent pilot or main flame operation until the purge cycle has been completed.

F H VALENTINE *Cleveland, Ohio*

EDITOR'S NOTE: *Have you readers any different theories on what caused this explosion? Send 'em in and we'll print them.*

Inner valves are machined on duplicating lathes to exacting standards. In this photo, master contour plate on lathe at (A) automatically duplicates the exact contour desired at (B) to form the inner valve.

Precision parts on BS&B Controls are manufactured to close tolerances. This lathe operator "mikes" inner valve for a final tolerance of .001". Other parts require tolerances of as little as 3/10,000"

In Automatic Controls,

BS&B Means..."Trouble-Free"!

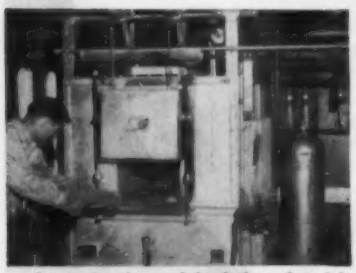
Ample production facilities and stocks of material assure prompt deliveries on all standard items in the BS&B Controls line.

Whenever you buy an automatic control, you look for the finest and most dependable one you can find for the job from the standpoint of quality, precision, long life and *"freedom from trouble."*

Freedom from trouble is especially important, because once a control is installed in the line, any "down-time" caused by its faulty operation becomes very expensive—usually many times more expensive than the entire cost of the control itself.

That's why it *always pays* to specify and buy BS&B Automatic Controls! Because of their superior quality and their long trouble-free performance, they'll *pay for themselves* in almost no time!

A Sinusoidal waveform apparatus is used to check the accuracy and performance of a BS&B Type 1440 Pressure Control Pilot.



Proper treating and hardening of certain component parts of BS&B Controls in one of these precisely controlled electric annealing furnaces is just one of the important manufacturing operations which assures their high quality and long trouble-free service.

Every BS&B Control must pass rigorous operating tests in our modern hydraulic testing and experimental laboratory. In this view, valves in the line are under test pressures from hydraulic pumps in the foreground. Operator checks readings on the control panel for valve performance.

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

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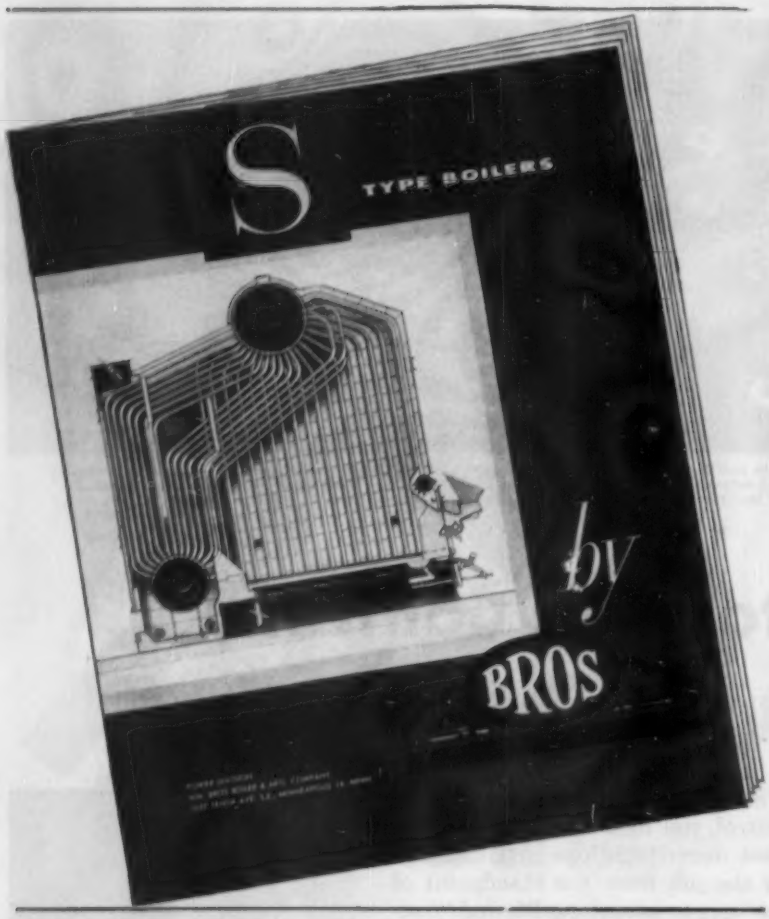

A higher standard for standard boilers!

Boilers, no matter what the application, can be very much alike in basic design. However, the Bros "S" Type Boiler (illustrated above) has in it many distinct features, selected over years of experience which result in:

1. *Higher burning efficiency*
2. *Lowest possible maintenance costs*
3. *Minimum space requirements*
4. *Simplified installation*

Bros "S" Type Boilers are pre-engineered to use standard components. This permits faster delivery and field assembly at a much lower cost.

If you are planning a new plant ... expanding ... or replacing an old unit, be sure to get full information on Bros "S" Type Boilers. Capacities range from 10,800 to 50,000 lbs. per hr. with design pressures up to 600 psi.

Write today for your copy of the new "S" Type brochure. It contains complete specifications and drawings.

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DESIGNERS AND MANUFACTURERS OF WATERTUBE BOILERS, 2-3-4 DRUM AND PACKAGED DESIGNS, AUXILIARY EQUIPMENT, AND A FULL LINE OF INDUSTRIAL STOKERS.

BOILER WASTES

Continued from page 99

burner adjustment, percentage of excess air and many other factors affect amount and location of slag deposits.

On furnace walls or furnace oulet screen tubes, slag formations may be harmful. If tubes are mostly covered so water circulation is slow, one small tube section may be bare and exposed to heavy heating. Poor circulation may allow overheating and damage the tube at the exposed section. Low heat absorption in the furnace because of slag deposits means that gas entering the superheater is overly hot. Then steam temperature may become excessive.

There are several ways to remove slag from waterwalls. Load changes may make it peel off. Hand lances using air, steam or water spray are effective if there are enough openings to reach most of the wall surfaces. Retractable mass blowers, set in the walls, are quite effective within a radius of eight or ten feet. Be sure they are set carefully to cover desired arc of travel and to cut blowing steam or air supply on and off at the proper point in the cycle.

On outlet tubes. To clean furnace outlet tubes and superheater inlet tubes, hand lances or long retractable mass blowers are generally effective. Short retractable blowers, operating from walls or roof, work satisfactorily on smaller boilers where the surfaces to clean are within the blower's range.

Retractable blowers are quickly damaged if left in the furnace without blowing steam or air passing through them. So it's good practice to check blower operations closely, particularly when using an automatic system.

Inspect furnace to see that large slag accumulations are not developing. Remove these before they become large enough to cause damage to screen tubes or ashpit as they fall.

In cooler parts of boiler and economizer, you can use nonretractable rotating blowers. These are less expensive than mass blowers, but must be made of material that stands up under the temperature encountered. See that arc of travel and axial adjustment are carefully set and checked at each boiler inspection to avoid damage to tubes or baffles. Idle elements become hotter than boiler parts and hence expand more. This affects the relative positions of nozzles and boiler tubes. Flyash carried by the steam or air jets can quickly cut into a tube.

Vary pressure in the blower by proper sizing of orifice in the steam supply. Use the effectiveness of blowing as a guide to the best pressure.

Preheaters, of the tubular or plate

STEEL FORGINGS by MESTA

for HIGH PRESSURE and HIGH TEMPERATURE PIPING

custom made to your mechanical and metallurgical specifications

TEES

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LATERALS

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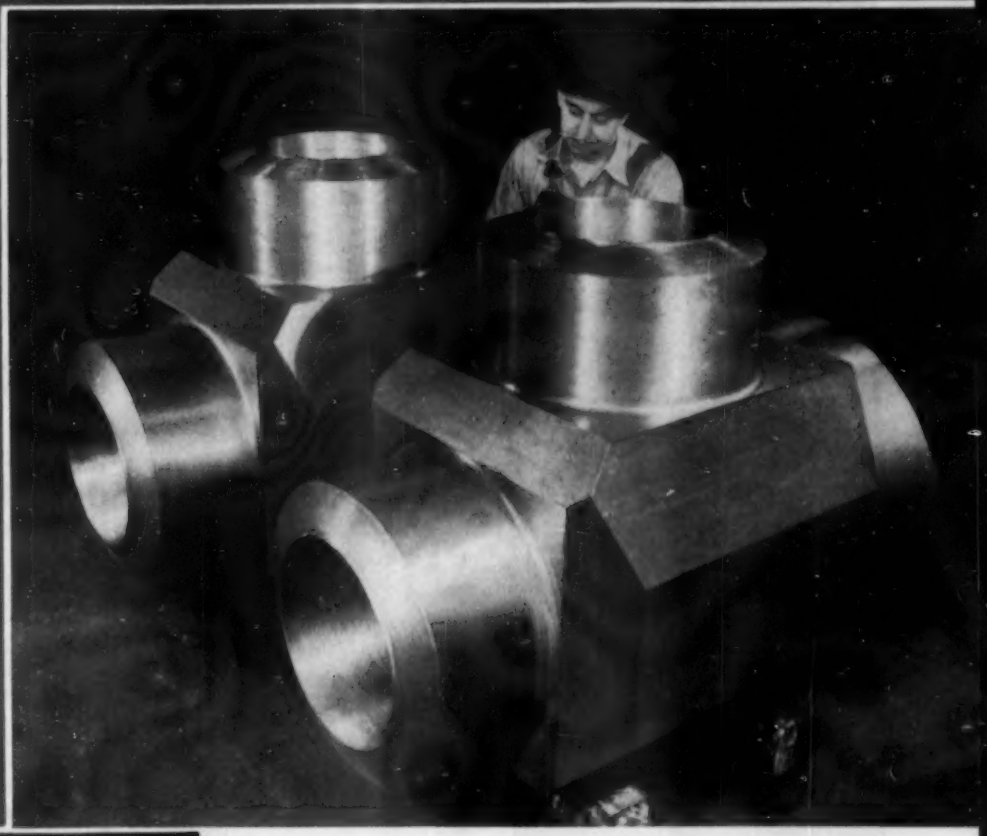


Experienced Furnace Crews at Mesta operating the Most Modern Equipment produce the High Quality Alloy Steels required to make High Pressure—High Temperature Pipe and Fittings.

Chrome Molybdenum Alloy Steel Tees forged, machined, rigidly inspected and tested to comply with customer and code specifications. Mesta Forged Fittings and Pipe provide confident service in High Pressure and High Temperature Piping Systems.

MESTA FACILITIES *for Forged Steel Piping*

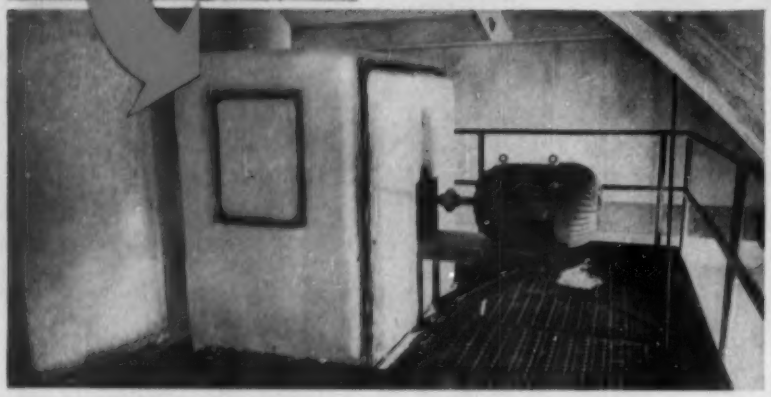
Electric Steel and Open Hearth Furnaces
Forging Presses • Heavy Duty Machine Tools
Chemical • Metallurgical • Physical Laboratories
Complete Testing Equipment

ROLLING MILLS • ROLLS • FORGINGS • HEAVY DUTY TOOLS

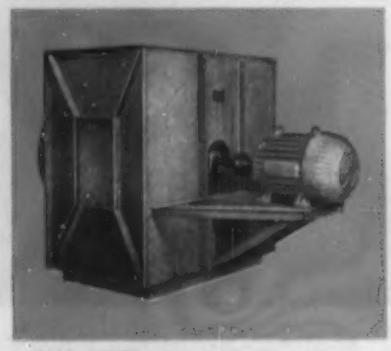
MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

WEST COAST VETERANS' HOSPITAL USES 4 WING PACKAGED POWER PLANT • DRAFT • INDUCERS



The above photo shows a recent installation of a motor-driven WING DRAFT INDUCER in a large Veterans' Hospital, serving a new 60,000 lb/hr boiler. Three previous installations of Wing Draft Inducers, each serving a boiler of similar size, are turbine-driven. Complete satisfaction with the 3 original units made selection of a Wing Inducer inevitable. Some of the reasons for this satisfaction are:



WING POWER PLANT DRAFT INDUCER
Turbine or Motor-Drive available. Fan and bearing assembly may be withdrawn from housing for inspection and servicing.

- **Big Savings in Space**
- **No Water Cooling of Bearings**
- **No Lubrication Needed**
- **Interchangeable Inlets—top, bottom or sides**
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BOILER WASTES

Continued from page 196

type, do not usually pick up much of a soot coating. In addition, they are difficult to blow properly, so soot blowers are generally omitted. Blower effectiveness on economizer surfaces is also rather questionable.

Regenerative-type air preheaters are equipped with soot blowers mainly to keep pressure loss low. Deposits on the surfaces seem to have little effect on heat transfer. A traveling mass-type blower is usually quite effective. It should cover the entire area of the heater surface, and blow with the flue-gas stream. But, on some installations with low exit temperatures you may have to blow from the cold end where most of the deposits form.

Blowing soot. In blowing soot or slag, try to have a sizable air flow through the boiler so dust, soot and fine ash go out without causing an explosive mixture. Adjust burners for good stability. Increase furnace draft and air flow slightly to avoid smothering fires and blow-back.

Proper sequence for soot blowing: Start cleaning in the furnace and blow along the gas path so material removed is not redeposited on sections cleaned.

If you operate blowers with no fire in the boiler, you still need a heavy flow of dry air. When using steam as the blowing medium, be sure it's dry, and preferably slightly superheated. Check that steam or air lines are well drained so no moisture combines with soot and cakes onto heating surfaces.

Admitting lime, calcium carbonate or proprietary mixtures to the furnace has had some success. These are mixed with the fuel or blown in separately. Users report slag and soot deposits are softer, more easily removed.

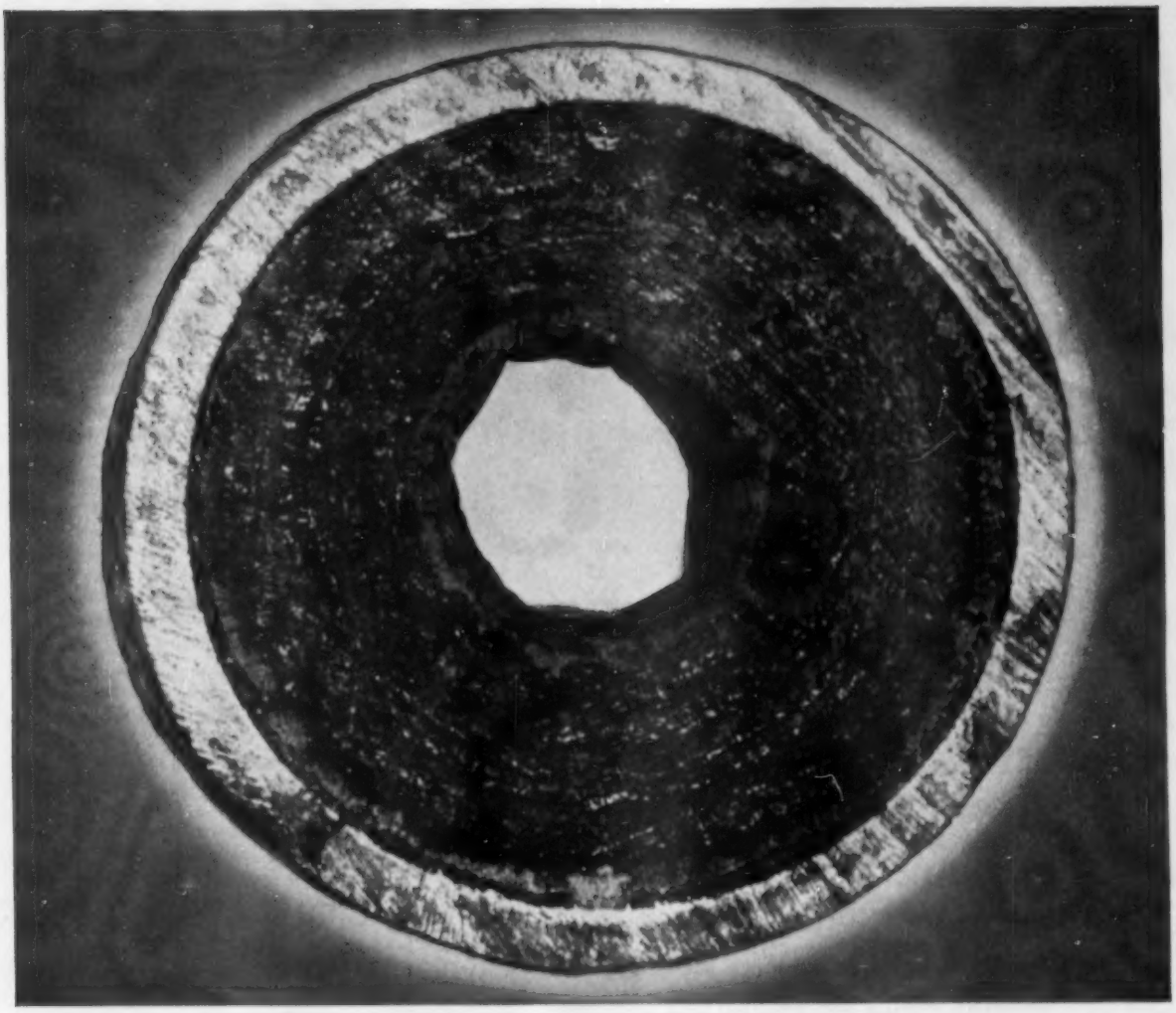
Here's another way to reduce deposits in cooler sections of the steam generator: coat the boiler and economizer surfaces with a lime whitewash mixture after washing them. This is particularly effective where fuel contains considerable sulfur.

Surface deposits on steam generators can often be loosened by moistening with a steam bath or by using a water spray. Take care to avoid wetting refractories or insulation excessively.

Air-preheater deposits are usually soluble in water. In a few instances, men have cleaned preheaters with water while units were in operation. This requires special provision for drainage.

SAFETY IN OPERATION

Safety valves are probably the most essential safety device on a boiler. They need adequate capacity to relieve maximum amount of steam a unit can pro-



END OF THE LINE

SCALE—layer upon layer of it—has reduced the inside diameter of this pipe to practically nothing. It's a common occurrence in some power plants, and the results are costly. The line must be taken out of service. That means production loss and expensive maintenance or replacement.

Scale, sludge, carry-over, and return-line corrosion are but a few of the problems that must be overcome to assure efficiency in boiler plant operation. In Dearborn's complete line of water conditioning products, there is the correct treatment to eliminate every water trouble—the properly balanced treatment to reduce unnecessary maintenance, avoid shutdowns, and protect valuable equipment.

Since 1887, Dearborn products have provided trouble-free water to users of steam in all types of industry. That's why, today, power engineers in leading industrial plants throughout the nation look to Dearborn for consultation and assistance in solving their water treating problems.

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Merchandise Mart Plaza, Chicago 54, Ill.
Please send me complete information on Dearborn Water Conditioning.

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Company.....
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...THEY NEED SO LITTLE ROOM

Gentile Flow Tubes are short. They need only minimum straight runs entering and following, and can be installed at practically any accessible point where flow conditions are reasonably steady.

Flow Tubes are furnished with individual head capacity curves, and for unusual piping arrangements, calibration curves for simulated conditions can be furnished.

Guaranteed

- Accuracy
- Minimum Head Loss
- Reproducibility

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FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE UNION, N. J.

AUTOMATIC VALVES • CONTROL VALVES • SAFETY VALVES • FLOW TUBES

BOILER WASTES

Continued from page 198

duce, without permitting steam pressure to rise above maximum allowable working pressure.

Set valves during overhaul so they pop at desired values. Then try them periodically by hand during operation. See that they are not sticking. With clean feedwater and steam, a monthly trial might suffice. On other units, daily valve lifting might be advisable.

See that safety valves are set with enough blowdown to keep them from pumping open and shut, as this soon causes damage. On the other hand, an unduly long blowdown means a lot of steam loss and a delay in resuming normal operation. Usually a blowdown of 3 to 4% of the valves' pressure setting is satisfactory. Electrically controlled power-control valves operate satisfactorily on 1 to 2% blowdown.

Be sure vent pipes carrying the steam away are well supported, well drained and adjusted so they do not contact the safety valves at normal pressures. When trying safety valves, stand well out of harm's way as birds' nests or other deposits may obstruct the vent pipes.

Water-level gage is another essential device. Blow down the water columns at start of each shift, or oftener if necessary, to be sure correct water level shows. Important boilers need two glasses or level-indicating devices. They should be readily visible from operator's normal position.

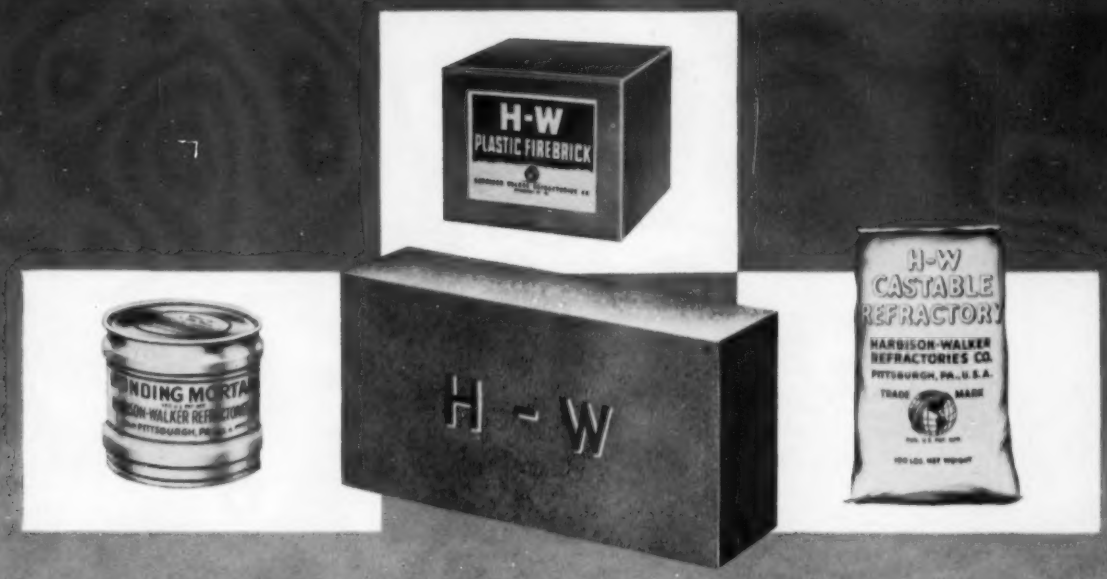
High- and low-water-level alarms should also be installed and kept in good condition.

Discontinue firing if water levels fall out of sight in gage glasses, or if you lose feedwater supply. If water level drops out of sight for any length of time, do not change rate of water supply. Most explosions occur because someone turns water into overheated metal sections of a boiler. Let the unit cool before adding water. Do not fire until after a careful inspection and hydrostatic test.

You need an accurate steam-pressure gage to avoid continual safety-valve popping and to keep pressure at the desired level.

Gages to show furnace-draft, air-supply and outlet-draft values will avoid puffs and blow-backs from furnace doors. Take particular care to avoid burning operators removing ash, cleaning slag, inspecting fires or otherwise working around the boiler.

Explosions. You may get a serious explosion in the gas side of a steam generator if an explosive mixture develops and becomes ignited. The mixture develops if a considerable volume of unburned fuel mixes with air in



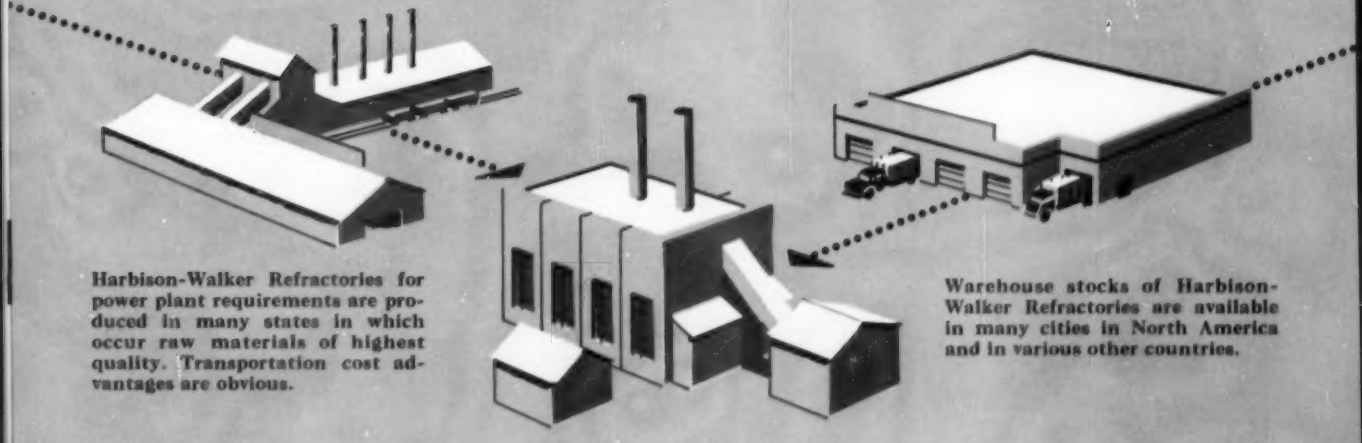
HARBISON-WALKER

REFRACTORIES

for every type of boiler furnace . . .

for every fuel . . .

AVAILABLE NEARBY



Harbison-Walker Refractories for power plant requirements are produced in many states in which occur raw materials of highest quality. Transportation cost advantages are obvious.

Warehouse stocks of Harbison-Walker Refractories are available in many cities in North America and in various other countries.

REFRACTORIES FOR ALL REQUIREMENTS. To meet the wide variety of operating conditions that exist in steam power generating plants, Harbison-Walker provides a complete line of refractories from which can be selected the exact types and brands for the most economical service.

You can secure maximum economy

by using HARBISON-WALKER

REFRACTORIES

Harbison-Walker products include the many different kinds of refractories needed in boiler settings of every type and for all fuels and firing practices. These provide the kinds of refractories that give maximum service with best economy in each particular application.

Harbison-Walker Refractories are used to advantage in industrial and commercial plants, as well as in central power stations. Listed below are the principal types and classes of refractory products which are regularly used for boiler plant requirements.

Technical service based on the most extensive experience and research is freely offered for assistance in determining the refractories best suited for each specific requirement.

A Complete Line of Highest Quality Products

REFRACTORY BRICK

The various brands of Harbison-Walker refractory brick used for walls, bottoms, arches, stacks, ash pits and other service comprise all classes of fireclay and high-alumina refractories. Included in the full complement of products are all the different kinds of basic and silica brick.

PLASTIC REFRACTORIES

Harbison-Walker plastic refractories are widely used for the construction of arches, target walls, baffle walls, burner ports and irregular shapes, as well as for making quick and economical repairs. These plastic refractories are made in both standard and super-duty classes. They are easy to install with the various H-W anchors and form durable, one-piece structures. Plastic Thermolith Batch is a chrome refractory and because of its chemical composition and dense impervious texture when heated, gives outstanding service in bottoms of slag-tap boiler furnaces.

CASTABLE REFRACTORIES

The development of castable refractories in a dozen specialized classes has resulted in noteworthy economies in the construction of furnace linings of irregular design and in the forming of difficult special shapes. They are shipped in dry form and when mixed with water like concrete may be poured, tamped into place or applied by means of air placement guns.

Among the various kinds of Harbison-Walker castable refractories used in boiler plants are: standard and super-duty grades, extra strength, high alumina, chrome, and lightweight classes as well as baffle mix. The wide variety of these specialized castables provides for every particular need.

INSULATING REFRACTORIES

Harbison-Walker insulating fire brick are made in seven brands, each of which is suitable for use over specific temperature ranges. Used as backing for the dense refractories which are required to withstand extremely severe treatment, they conserve heat and reduce the weight of the furnace lining. In addition to the conventional and special brick shapes, Harbison-Walker insulating refractories are available in the form of lightweight castables, block insulation and mineral fiber coating material.

MORTARS

The bonding mortars for boiler furnace requirements should be selected as carefully as the refractories with which they are used. The choice depends upon the kind of refractory and the service conditions. Harbison-Walker produces both hot and cold-setting mortars of various compositions having special characteristics for specific applications. Harwaco Mastic is a specialized product having a consistency similar to stiff putty which makes it ideally suited for plastering with a trowel as for example, in sealing the V-shaped spaces at the exterior face of tangential tubes in water-well boilers.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Largest Producer of Refractories
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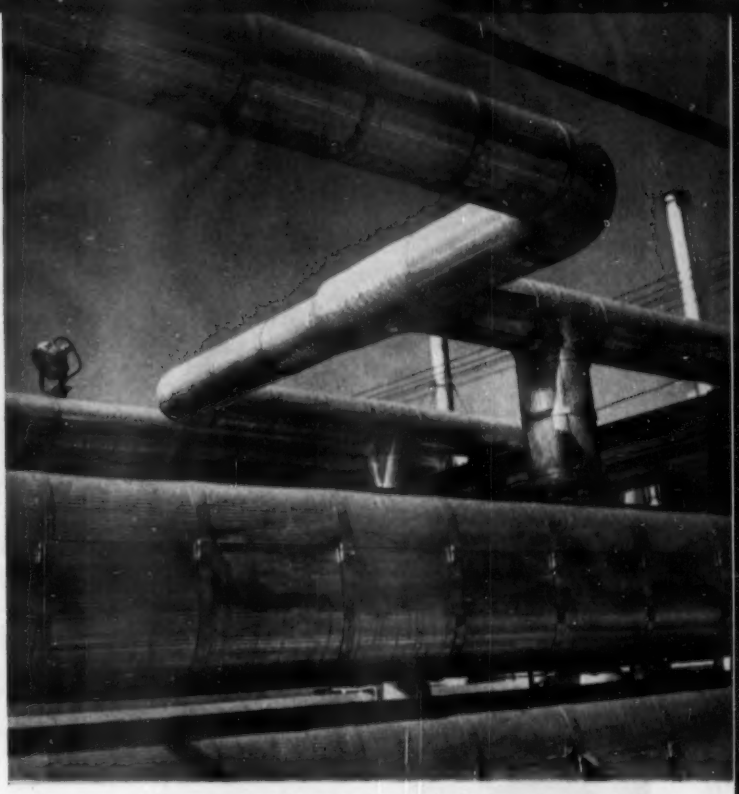
How Olin Mathieson Uses Childers Jacketing For Insulated Lines

Jacketing problems at new plant ranged from covering tall towers to irregularly-shaped heat exchangers. Read how aluminum jacketing solved these problems.



More than 244,000 square feet of Childers .006" Jacketing and 35,000 square feet of heavy weight Childers Jacketing was used in this new Olin Mathieson plant to weather-proof insulated lines, towers and vessels. Close-up above shows how aluminum jacketing was applied with strapping and seals.

Low first-cost, long life, and easy installation were the big reasons Olin Mathieson Chemical Corporation used Childers Aluminum Jacketing for outdoor insulated lines in their new Brandenburg, Ky., petrochemical plant.

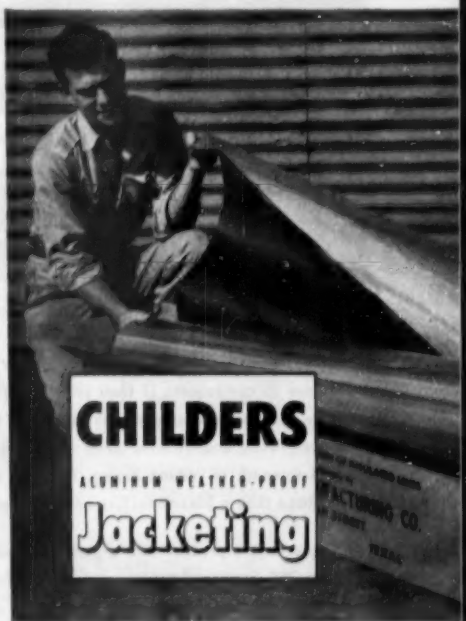
Mathieson used Childers standard weight Jacketing on their insulated lines. Heavier weights of Childers Jacketing were used on high towers and vessels where a stiffer material was needed to support the vertical weight of the jacketing.

Engineers report that Childers Jacketing is inexpensive to apply. It comes in easy-to-handle rolls 4 ft. wide and 100 ft. long. Just pliers and a pocketknife are the only tools needed to apply. And because the jacketing is aluminum it needs no painting . . . stays clean and new looking even after years of service.

Childers Jacketing is easily removable, too. Just remove the strapping and jacketing can be taken off for inspection of the lines. Then same jacketing can easily be put back on the insulated line.

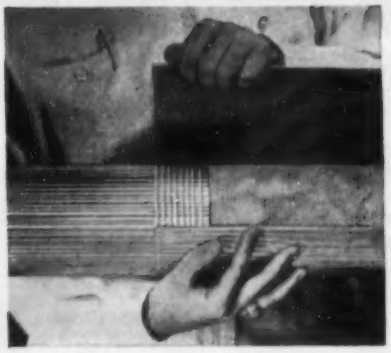
Immediate shipment from our large factory stocks can eliminate costly delays in construction or plant improvement schedules.

Try this low-cost protection in your plant. Write today for engineering data and information. You can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. Address: Childers Manufacturing Company, Department PR-28, 3620 West 11th St., Houston, Texas.



Each roll of Childers Jacketing comes individually packed like this in a heavy corrugated carton. Rolls are 4 ft. wide. With moisture barrier attached they are 100 ft. long; without moisture barrier they are 200 ft. long. They are well protected for field storage if kept dry. Individual boxes are light enough for one man to handle. (Adv.)

Only Childers Jacketing Offers *LAP-SEAL*



LAP-SEAL **is a series of eight ribs rolled into the underlapping edge of the jacketing.**

LAP-SEAL **makes more positive weather seal.**

LAP-SEAL **saves labor—2" ribbed edge eliminates measuring for circumferential lap.**

LAP-SEAL **(patent applied for) is an exclusive "plus" available on all Childers Jacketing at no extra cost.**

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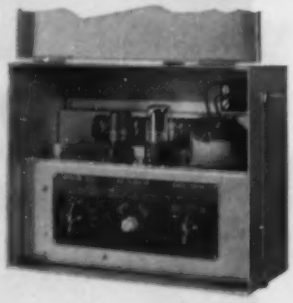
CONSTANT TEMPERATURE, HUMIDITY

Electronic Controls

- Provide fully automatic control of temperature and humidity in areas where constant maintenance of desired conditions is of high importance
- Control is ultra-sensitive to a fraction of a degree in a range of 20° to 120° F, 25% to 90% relative humidity — no drift or shift from control point
- Get remarkable flexibility — control temperatures from an average of several points, use secondary elements to compensate for changes, control sequences to match job requirements
- Two-position or proportioning types
- Complete selection of equipment — motor-operated valves, control motors, program switches, sensing elements, humidistats, thermostats — from a pioneer manufacturer of electronic devices



- Use Barber-Colman's experience, gained in installations throughout the nation

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Why Viking Pump is the

MANUFACTURERS' MANUFACTURER

Many original equipment manufacturers include Viking Pumps as components of their products. Vikings make possible custom-engineered pumps that serve their needs better, and at mass production prices. They benefit from more than forty-four years' experience, engineering skill and research on Viking Pumps. In many ways, Viking facilities serve to better advantage than a branch factory or special pump department.

If you have a product with a pumping problem, call on Viking engineers. With more than 750 cataloged models and thousands of specially applied pumps, Vikings may solve your problem at a big saving. For information, write for Bulletin Series 55Sw.

VIKING PUMP COMPANY Cedar Falls, Iowa, U.S.A.

In Canada, it's "*ROTO-KING*" pumps

THE ORIGINAL "*GEAR-WITHIN-A-GEAR*" ROTARY PUMP

BOILER WASTES

Continued from page 200

proportions right for rapid combustion. This happens if you lose ignition, and fuel and air continue to enter the furnace through one or more burners. Ignition loss usually results from a temporary interruption in fuel supply, or from an oversupply of air great enough to snuff out fire at the burner.

Another cause of explosive atmosphere may be a gas leak into an idle boiler. Stokers are relatively free from explosion hazard.

The various safety devices that prevent furnace explosions are designed to (1) cut off fuel if unstable furnace or fuel-supply conditions develop and (2) assure that there is adequate time and air flow to purge the boiler of explosive gas before fuel supply can be re-established.

For protection against furnace explosions, trips to cut off fuel are used singly or in combination if the following conditions develop: (1) Furnace pressure exceeds a positive pressure of 1 to 3 inches of water. (2) Fire is lost. (3) Gas-burner header or supply header drops to a set minimum value. (4) Pulverizer exhauster outlet rises above a set maximum. (5) Differential across the exhauster falls below a set minimum. (6) Fan speeds fall below a certain minimum. (7) Power supply to auxiliaries is lost for more than a second or two.

Alarms are often used to warn of dangerous conditions without actually cutting off fuel supply.

Combustion safety is assured if (1) ignition torches are used to light off each burner (2) burners already lighted are checked to be sure they remain lit (3) fuel and air flow are not allowed to become badly unbalanced so burner stability is lost (4) adequate purging clears out unburned fuel or gas before fire is lighted off or relighted.

NUCLEAR STUDY

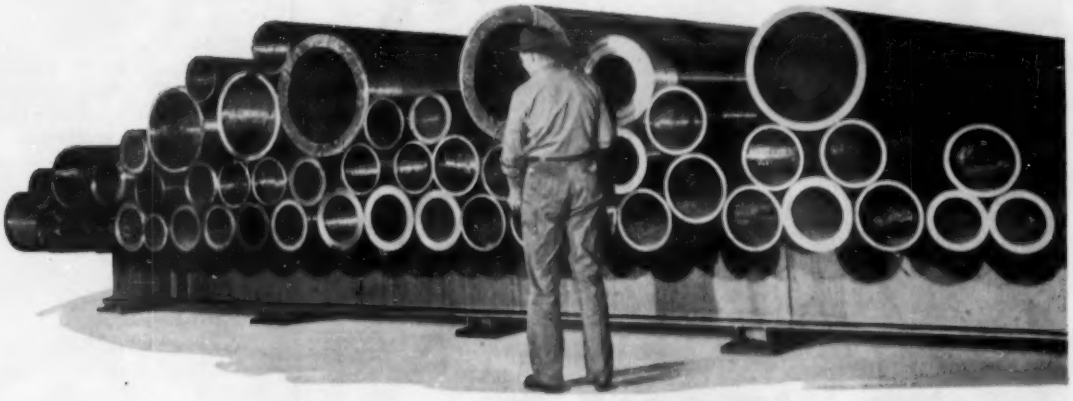
Continued from page 94

struction difficulties (2) lower over-all heat transfer that must be compensated by more heat-transfer surface (3) higher cost.

Fig. 4 shows a Babcock & Wilcox once-through boiler with single tube walls. U-tube construction again takes care of expansion. This unit would be used with a secondary coolant circuit, especially in a fast reactor plant.

In comparing double-tube-wall with single-tube-wall boilers the following must be considered: (1) effect on radioactive containment-and-exclusion-area costs (2) costs and advantages of

B&W Offers
HOLLOW FORGINGS In A Wide Range of Sizes



B&W Hollow Forgings are produced in a large range of fractional inch sizes and a selected range of standard pipe sizes in accordance with the following ASTM Specifications: A 106-52T seamless carbon steel pipe for high-temperature service. A 266-54 carbon steel seamless drum forgings. A 312-54T seamless and welded austenitic stainless steel pipe. A 335-53T seamless ferritic alloy steel pipe for high-temperature service. A 376-54T seamless austenitic steel pipe for high-temperature central-station service.

Carbon Steel and Intermediate Alloys

Outside Diameter: 9¼ inches to 35¾ inches
Wall Thickness: ¾ inch to 5⅜ inches

STANDARD PIPE SIZES
AVAILABLE AS HOLLOW FORGINGS

Size Inches	Nom. OD Inches	Schedule Nos.
10	10¾	120–140–160
12	12¾	100–120–140–160
14	14	100–120–140–160
16	16	80–100–120–140–160
18	18	100–120–140–160
20	20	100–120–140–160
24	24	100–120–140–160

These pipe sizes are in complete agreement with ASA standard No. B36.10-1950.

Austenitic Stainless Steels

Outside Diameter: 9¼ inches to 33¾ inches
Wall Thickness: ½ inch to 4½ inches

MINIMUM WALL EQUIVALENTS OF
STANDARD PIPE SIZES AVAILABLE
AS STAINLESS STEEL HOLLOW FORGINGS

Size Inches	Nom. OD Inches	Schedule Nos.
10	10¾	80–100–120–140–160
12	12¾	60–80–100–120–140–160
14	14	60–80–100–120–140–160
16	16	60–80–100–120–140–160
18	18	80–100–120–140–160
20	20	100–120–140–160
24	24	100–120–140–160

For the complete range of B&W Hollow Forgings plus other important information on what B&W has to offer you in Hollow Forgings, send for Bulletin S-16B. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

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BOILER DIVISION

S-446

Every RIDGID Pipe Tool
TESTED
individually before shipment
Extra Fast...
...easy...pipe reaming
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Spiral . . . turns into the work smoothly, no chatter. Famous RIDGID heat-treated cutting edges mean clean reaming, extra long service. Quick enlarging of conduit box outlets—and holes in sheet metal. More for your money—buy the 2-S at your Supply House.
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NUCLEAR STUDY

Continued from page 202

secondary coolant system and auxiliaries (3) installed cost of boiler units (4) effect of coolant-system circuit time and heat storage on over-all plant performance, especially during transients.

Unit in Fig. 4 would use stainless steel for all parts in contact with liquid metal. It may be possible to adopt low-alloy ferritic steels in the not-too-distant future. Feedwater would enter the unit at 300 F and steam leave at 1200 psig, 800 F. NaK enters boiler at 900 F and leaves at 600 F. The tubes would be ½-in. OD with a wall thickness of 50 mils, set on ¾-in. equilateral pitch.

Heat-transfer coefficients for water and steam in the tubes with NaK on the shell side run about:

a. Feedheating section:	*Btu*
h—feedwater	1100
h—NaK	6000
U—overall	550
b. Boiling section:	
h—boiling, up to 70% vapor	6000
h—boiling, 70 to 100% vapor	2000
h—NaK	6000
U—up to 70% vapor	1200
U—70 to 100% vapor	800
c. Superheating section:	
h—steam	550
h—NaK	6000
U—overall	350

With the higher-pressure water and steam inside the tubes a considerable saving can be realized in shell material thickness.

Special problems for a single-tube-wall once-through boiler using a liquid metal as a heat source include:

1. Start-up and shutdown procedures.

2. Feedwater treatment and oxygen control. All treatment must be external to boiler—dissolved solids should not exceed 0.5 ppm and oxygen concentration not above 0.005 cc per liter —pH must be held between 8 and 9.

3. Water and steam circuit stability.

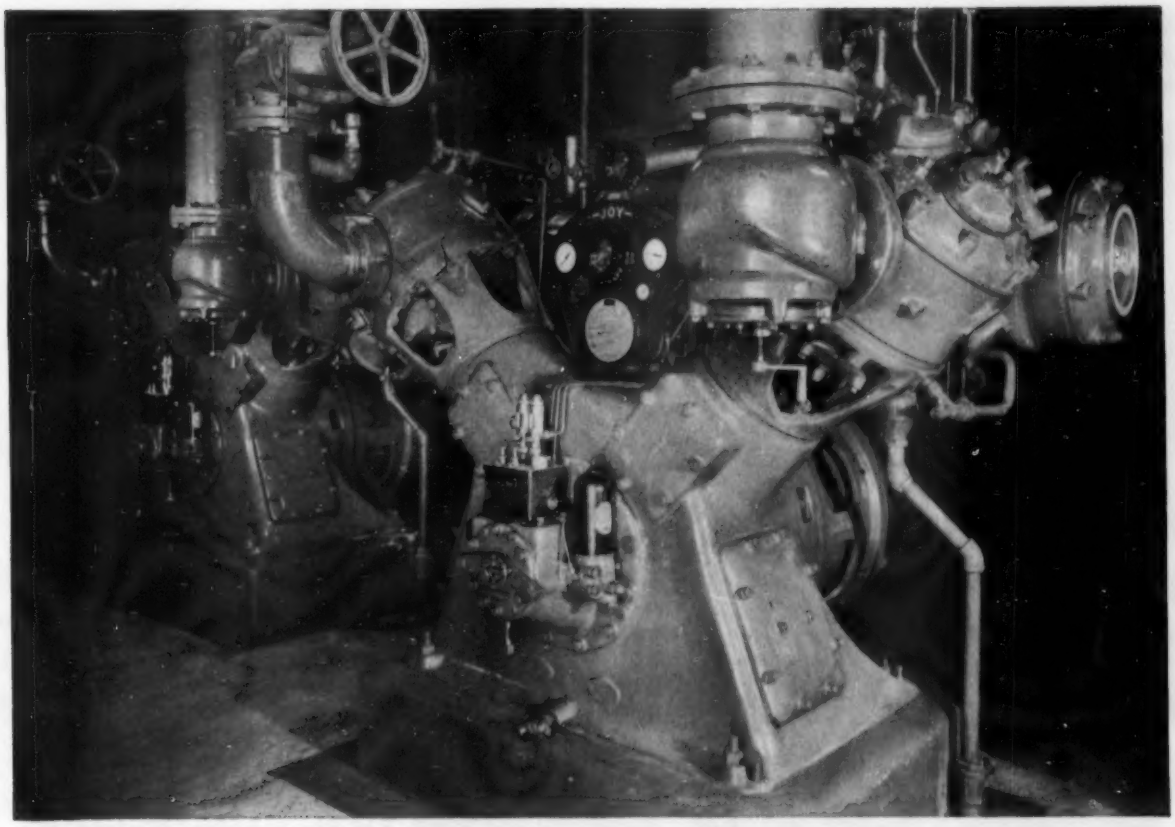
4. Total stress in tube material in boiling zone, especially in 50 to 80% vapor (No. 12, August 1955, p 96, Fig. 7). Thermal gradient in tube material may be 70% of total thermal gradient in section and thermal stress alone may approach or exceed yield point of material—depends on thermal conductivity and wall thickness of tube.

5. Effect of system thermal transients on materials, unit components.

6. Mass transport and corrosion.

7. Effect of system thermal transients on steam pressure and temperature available to turbine.

For normal steady-state operation



The Case of the "GOOD AS NEW" COMPRESSORS

These two Joy WN-112 air compressors were used for several years in really heavy-duty operation under extremely tough conditions.

They were installed at different times . . . the newest about four years ago. Plant personnel report that, with nothing more than customary plant maintenance, they are still "good as new" and still furnishing, without shutdowns, the air to keep the plant in operation.

Durability and easy maintenance are built-in features of Joy WN-112 compressors. Cylinder and crosshead liners are field-replaceable, and made of alloy iron, honed to a mirror finish. Large area, low lift Joy "Dual Cushion" valves are set at the most efficient angle in both heads. Lubrication is by force-feed to all moving parts with automatic shut-off protection.

The Joy WN-112 is a heavy-duty, continuous service, two-stage, double-acting compressor of V-vertical design. It is normally powered by a flange-mounted motor but is adaptable to diesel, steam turbine, flexible coupling, V-belt or flat belt drive. It is a versatile machine and a compact space-saver in any plant.

For complete details on the Joy WN-112, write for Bulletin A-62 to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario*

W&D 1 8507

Consult a Joy Engineer

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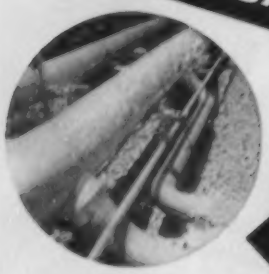
JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

4500 psi Recycling Plant

$ 18,000 SAVED on branch connections alone!



By requesting the alternate use of Weldolet Welding Fittings in all weights and sizes the piping contractor was able to lower his bid sufficiently to be awarded the job!

This recently completed recycling plant in Louisiana was designed and engineered in full accordance with the ASA and ASME Codes and operates at a maximum pressure of 4500 psi and 225°.

The piping engineers on this job were confronted with a number of tough problems. The plant was to be operated at extremely high pressures. The terrain was swampy which meant the fittings had to withstand the additional stresses exerted by a settling foundation. The piping also had to stand up under rugged vibration conditions. The many design features of Weldolet Welding Fittings in both full size and reducing size outlets provided the safe, practical and most economical answer to these knotty service problems.

BONNEY

WELDING FITTINGS DIVISION

FORGE & TOOL WORKS

732 MEADOW STREET, ALLENTOWN, PENNA.

NUCLEAR STUDY

Continued from page 204

steam pressure at the boiler outlet is controlled by regulating feedwater flow to boiler. Steam temperature does not need to be controlled since it depends on the inlet coolant temperature. Fig. 5 shows temperature variations in a nuclear plant using both primary and secondary liquid-metal coolants when both flows are held constant, while load is varied by changing the temperature differential. Fig. 6 shows the variations when coolant temperature differentials are held constant and the coolant flows varied with load.

If steam temperature exceeds allowable level for the turbine, it may be necessary to desuperheat. If steam temperature drops rapidly, it may be necessary to bypass the turbine to avoid water erosion in the turbine stages. The bypassed steam would be desuperheated and dumped to the condenser. This latter feature may be helpful to minimize effects of rapid load drops on reactor operation.

Atomic Power Development Associates, Inc is currently having a pilot unit of the once-through boiler, Fig. 4, with NaK as a heat source, fabricated by Babcock & Wilcox for special testing. This will determine the feasibility of using such a unit in a fast-breeder-type nuclear power plant.

The next installment will cover reactor vessels and control, fuel handling, auxiliary systems, plant control, specifications—in a forthcoming issue.

PLUG VALVES

Continued from page 181

cated plug valve is compact with no projecting yokes, bonnets or body. Simple in design, it has only three basic parts—body, cover and plug. A quarter-turn fully opens or closes the valve. Since actuation is by rotation only, and not by raising and lowering the movable valve member, the seat is protected and clean.

Lubricant pressure exerts a jacking action against the smaller end of the valve plug, momentarily unseating it. This permits unseating the valve without using hammer or wrench. Lubricant is distributed around the plug and body by grooves. When valve is closed, the ports are completely sealed by a lubricant film between the ground sealing surfaces.

The valves are lubricated by a pressure-gage-equipped gun. The operator assigned to a particular area lubricates each valve once a week. In five years little has been spent on valve repair.

Calumet Division, Calumet and Hecla, Inc., Calumet, Michigan

"Cities Service Heat Prover Played A Major Role In Our Expansion Program"

Miners and refiners of copper, the Calumet, Michigan Division of Calumet and Hecla, Inc., relies on two power plants to operate its many mines, reclamation plants, mills, manufacturing facilities and mine rehabilitation projects.

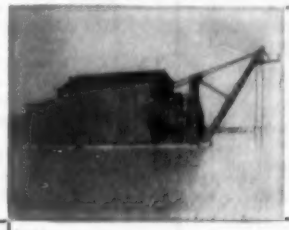
The two plants, located at Lake Linden and Hubbell, were recently brought up to date. The Lake Linden plant now has modern steam generating equipment fired with pulverized coal. The Ahmeek plant was equipped with new coal distributors for its underfeed stokers and new plastic monolithic furnace settings.

This modernization program, along with a planned preventive maintenance program which is now being put into effect, is expected to raise the KW capacity of these plants from 20 megawatts to 30 within the next few months.

The Cities Service Heat Prover has played a major role in this improvement program. It is used extensively to examine combustion conditions in the furnaces, check station instruments, and guard against air infiltration through boiler settings and duct work, thus enabling plant personnel to operate the equipment constantly at design efficiencies or better.

Says Power Superintendent, Robert Hein: "The portable Cities Service Heat Prover has proved invaluable in our operation. We are now using 150,000 tons of coal per year and operating at boiler efficiencies around 86%. By giving us a quick, accurate check on our firing conditions, the Heat Prover has been directly responsible for much of this record."

The Heat Prover is supplied and maintained free by Cities Service. For further information write Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.



Calumet Reclamation Operation reclaims stamp sands processed years ago and dumped into lake. Further processing will extract copper. For power, dredge relies on the Calumet Division's Lake Linden Power Plant.

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MATCHING MOTORS

Continued from page 167

responsive to speed, temperature or other control requirements. It provides one means of combining the power-factor correcting ability to synchronous motors with the precisely-controllable adjustable speed desired for many applications. Hydraulic slip couplings with the same general characteristics are also available.

Exciters will be direct-connected to synchronous motors at 1800 rpm or less, except outdoor motors and those in explosive areas. For all 3600-rpm synchronous motors, for outdoor motors and where explosive conditions may prevail, use motor-generator sets located preferably with main motor control. Sometimes the location may be pressurized with nonexplosive air to eliminate hazard.

More FREE LITERATURE

Begins on page 167

ELECTRICAL EQUIPMENT

10 **Load tap changing equipment,** for transformers up to 7500 kva, three-phase step voltage regulators to 750 kva and all sizes of single-circuit unit substations, is subject of 16-p bulletin 5506. Pennsylvania Transformer Co, Box 230, Canonsburg, Pa.

11 **Lighting wires** and power cables. Bulletin RSS-53 establishes performance tests for asbestos insulation applied as a felted wall in combination with varnished cambric tapes for wires and cables with 600 and 1000 volt ratings. Rockbestos Products Corporation, New Haven, Conn.

12 **Step regulators.** Illustrated 6-p bulletin 21R8317 is entitled "How to Increase Step Regulator Ratings." Material shows how losses of step regulators decreases as tap changer moves closer to neutral position and how it is possible to increase current ratings when operating on these taps. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

13 **Vibration protection.** Two-page bulletin 500-4 describes electronic *Vibraswitch* used for protection of heavy equipment against damage in event of malfunction causing increased vibration. The Beta Corp, Forest Ave at Ridge Rd, Richmond 26, Va.

INSULATION

14 **All-silicone-rubber** insulation system, *Silco-Flex,* for motor and generator stator windings is discussed in 4-p bulletin 05R8341. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

15 **Cellular glass insulation,** *Foamglas,* for piping and equipment is sub-

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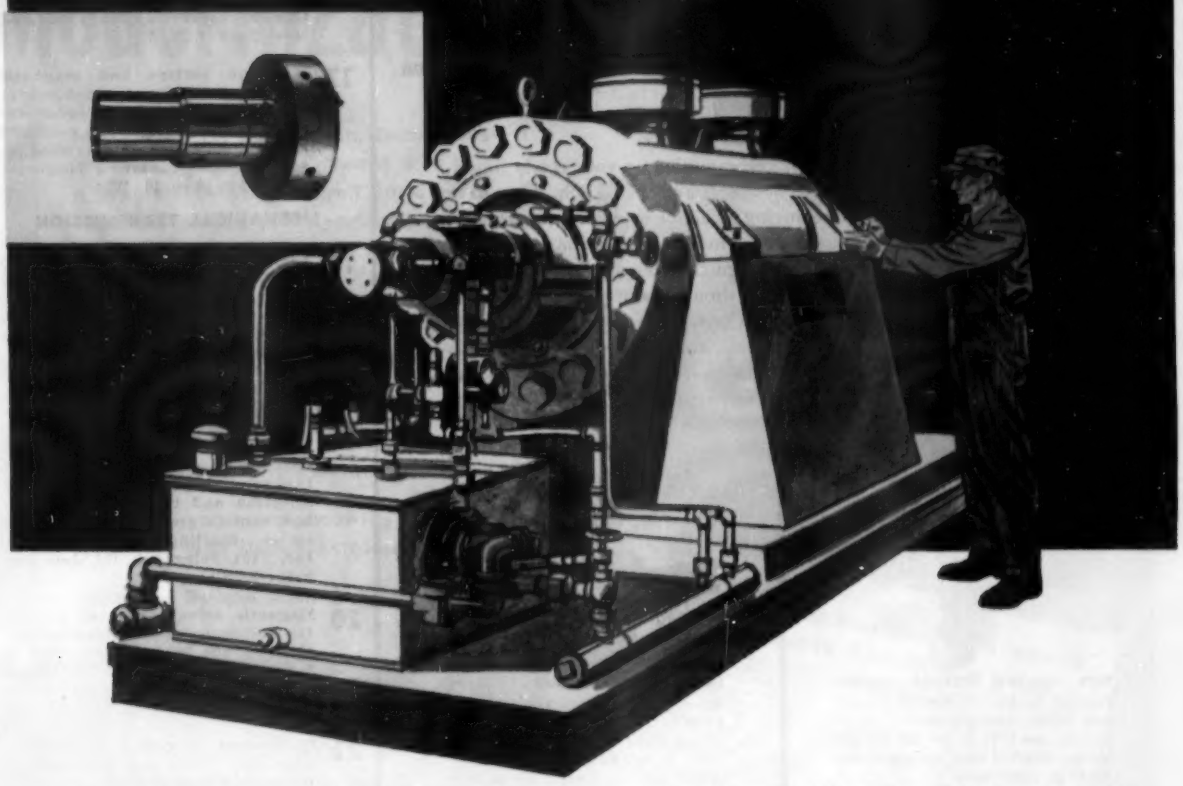

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More FREE LITERATURE

Begins on page 167

ject of 8-p bulletin FI-103. Presents physical properties, sizes and shapes, suggested thicknesses required for temperatures from −500 to 800 F. Pittsburgh Corning Corp, One Gateway Center, Pittsburgh 22, Pa.

MATERIALS HANDLING

16 **Plunger electric elevators** designed for low-rise, light and heavy duty freight - handling requirements, ranging from 2500 to 20,000 lb, are described in 12-p bulletin A-414. Otis Elevator Co, 260 11th Ave, New York 1, N. Y.

17 **Magnetic pulleys** and magnetic pulley separators are subject of 16-p bulletin 203C. Includes detailed specs, simplified selection method, operation data, typical installations. Stearns Magnetic, Inc, Milwaukee 46, Wis.

MECHANICAL TRANSMISSION

18 **V-belt drives.** Multi-color 74-p booklet 20P40 contains selection tables for A, B, C, D and E *Texrope* belts; features info on design, basic-drive principles and technical data on sheaves. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

19 **Variable-speed drives** are discussed in illustrated 8-p bulletin 188. Includes data on inner workings of the positive pulley design, drive selection and types of automatic and remote speed control accessories. Sterling Electric Motors, Inc, 5401 Telegraph Rd, Los Angeles 22, Calif.

20 **Magnetic drive** for speed control fan and pump applications or constant torque loads is described in 4-p bulletin 4400-PRD-229. Electric Machinery Mfg Co, Minneapolis 13, Minn.

21 **Mechanical couplings.** Flexible-gear-type units are described in illustrated 12-p bulletin. Philadelphia Gear Works, Inc, Erie Ave & G St, Philadelphia 24, Pa.

PIPING, VALVES, FITTINGS

22 **Asbestos-cement pipe** for water systems. Illustrated 8-p bulletin TR-160A gives procedures for installing Transite pressure pipe and assembling the *Ring-Tite* coupling. Johns-Manville, 22 E 40th St, New York 16, N. Y.

23 **Expansion joints** and pressurized *Hydropads* are detailed in 36-p bulletin 52. Includes details of construction, specs and application data. Cook Electric Co, 2700 N Southport Ave, Chicago 14, Ill.

24 **General-purpose valves.** Illustrated 32-p bulletin F-9 includes data on gate, globe and angle types, sizes ¼ through 2 in. Henry Vogt Machine Co, Louisville 1, Ky.

25 **Gate valves** and check valves for corrosive services. Rubber-lined

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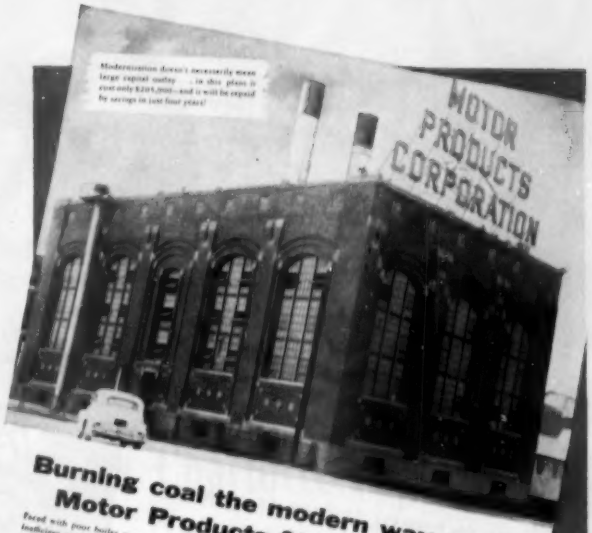

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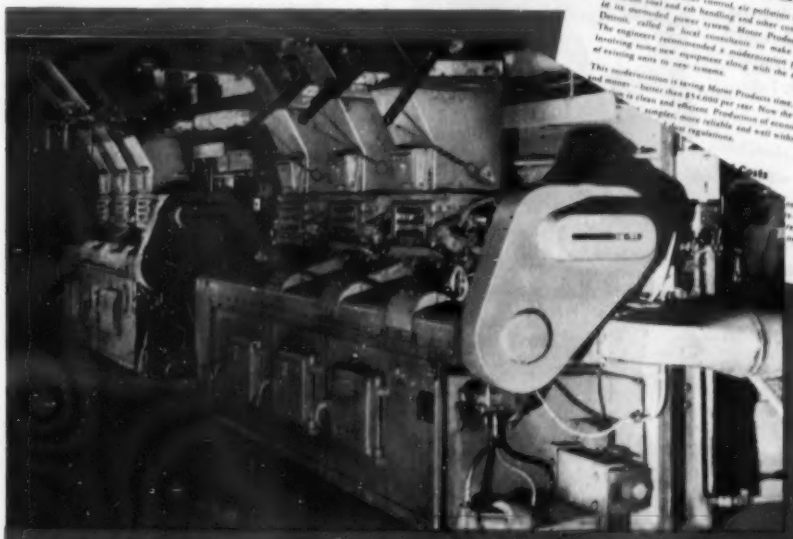

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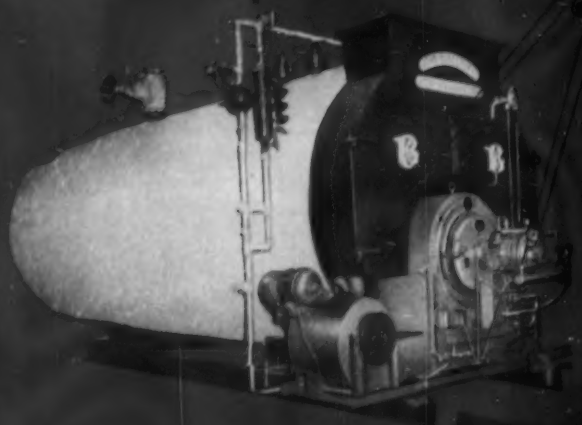

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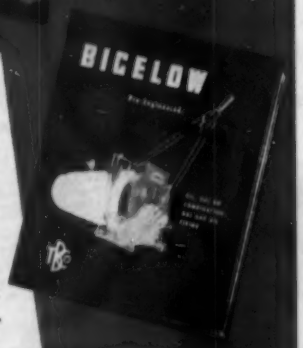

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BI-17

More FREE LITERATURE

Begins on page 167

units are described in 4-p bulletin. Darling Valve & Manufacturing Co, Williamsport, Pa.

26 **Pressure reducing valves** (bulletin 401) and temperature control valves (bulletin 501). Each bulletin contains 16-pp, schematic drawings, full specs. Specify bulletin desired. Warren Engineering Co, Broadway, N. J.

27 **Automatic regulating valves** for level and pressure control of steam, air, gas, oil and water are described in 4-p bulletin 4. Schade Valve Manufacturing Co, 2527 N Bodine St, Philadelphia 33, Pa.

28 **Forged-steel valves.** Illustrated 6-p bulletin 551 gives details on stop, stop-check and needle valves for a variety of applications. Edward Valves, Inc, 1201 W 145th St, East Chicago, Ind.

29 **Control valves,** pilot operated, which convert from pressure reducing and regulating to back pressure control by a simple switch of control lines are described in 4-p bulletin 966. A W Cash Co, PO Box 551, Decatur, Ill.

30 **Welding fittings,** manufactured from seamless steel tubing and available in alloy, carbon and stainless grades, are described in 6-p bulletin FB-500. The Babcock & Wilcox Co, Tubular Products Division, Beaver Falls, Pa.

MISCELLANEOUS

31 **"Ford's Rouge Plant** Gets Another Boost in Steam Generation" is title of three articles reprinted from POWER. Available from The Kuljian Corp, 1200 N Broad St, Philadelphia 21, Pa.

32 **Boron carbide** and elemental boron. Illustrated 16-p bulletin provides technical info on materials made for use in the atomic energy field. Norton Co, Worcester 6, Mass.

33 **Electronic controls** is subject of 16-p bulletin EC-1. Contains nontechnical info on installation, performance and maintenance of the basic *Dynamatic* electronic control. Dynamatic Division, Eaton Manufacturing Co, Kenosha, Wis.

Mexico Refractories Co, Mexico, Mo, is celebrating its 25th anniversary this year.

A nuclear energy department has been formed at National Research Corp to coordinate company activities in the atomic field.

A multi-million dollar transformer and circuit breaker manufacturing expansion program at Allis-Chalmers Manufacturing Co's Terre Haute, Ind., and Gadsen, Ala., plants has been announced by J W McMullen, vice-president, transformer and switchgear equipment.

West Charlotte Senior High School, Charlotte, N. C.
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Youngstown's Yoloy Pipe is shown in the process of being installed. In a radiant heating system like this, the pipe must be good as it's put there to stay.

YOUNGSTOWN YOLOY PIPE chosen for radiant heating system at West Charlotte High School

This handsome school won a First Award in the 1955 School Executive magazine competition. It also won an A.I.A. Award of Merit. Justifiably, too, as it is the result of years of planning by a group of Charlotte's educators and architects.

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More TECHNICAL BRIEFS

Begins on page 154

dictions of the simplified theory. Dimensionless plots of pressure distribution are presented with experimental curves of flow rate versus pressure ratio for various ratios of passage length L to passage height h. These plots, together with simple equations, have been prepared for direct use by the designer. *ASME paper No. 55-SA-13.*

Streamlined pitot-tube bar for measuring water flow in large pipes. *By Professors F. Numachi, H Murai and S Abe, Tohoku University, Sendai, Japan.*

With the aim of measuring flow through pipes of large diameter, a "streamlined pitot-tube bar" was devised; it is described in this paper. Basic studies, both theoretical and experimental, were carried out in a preliminary way on the cross-sectional form of the bar in order to obtain best results. Based on the sectional form finally selected, a full-size model was prepared and tested, from which pitot coefficient and other pertinent data were obtained. Two actual pitot-tube bars of 60-mm chord and 2.000-m length were constructed and used in measuring flow in the main pipe of the pump installed at the Numazawanuma storage system hydroelectric station. *ASME paper No. 55-SA-25.*

Resistance coefficients for accelerated and decelerated flows through smooth tubes and orifices. *By J W Daily, and J M Jordaan Jr, Massachusetts Institute of Technology, and W L Hankey Jr, Wright Patterson Air Force Base, and R W Olive, General Electric Co.*

In the prediction of transients involving hydrodynamic or aerodynamic phenomena, it has been customary to calculate pressure variation and fluid resistance neglecting possible effects of unsteadiness on the mechanics of the fluid motion. There are several areas for which knowledge of the effects of unsteadiness would be useful. Included, for example, are transient resistance and stability of accelerating missiles and other immersed objects, flow-meter coefficients with pulsating flows, and transient hydrodynamic performance of pumps, compressors and turbines.

The latter is a case where under many circumstances steady-state performance has been used with good results in predicting transient pressures and machine accelerations and decelerations. Yet, recently, in connection with pumps of special design, discrepancies between measured and calcu-

Directions for ordering papers on p 222

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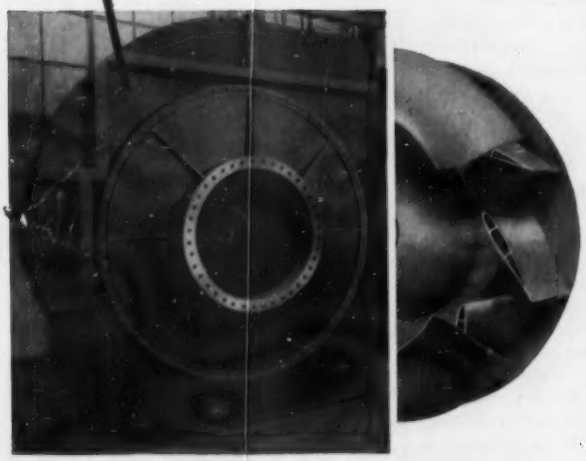
FLY ASH AND DUST COLLECTORS



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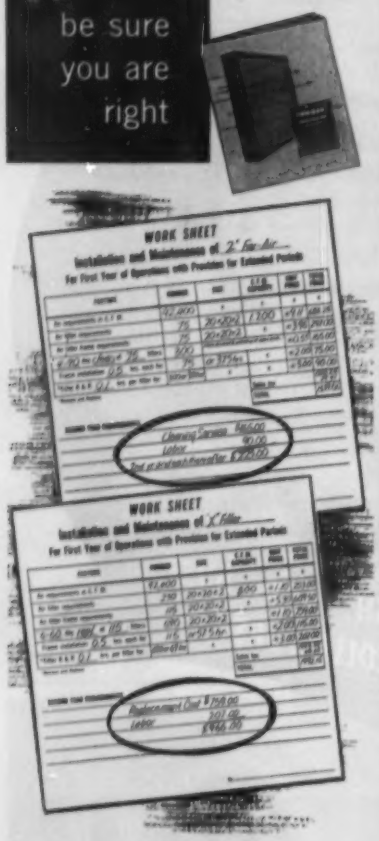

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More TECHNICAL BRIEFS

Begins on page 154

lated transients have indicated what is probably an effect of unsteadiness on the basic fluid motion. In all cases a basic question is the effect of unsteadiness on fluid shear and turbulence generation, and resulting effects on inertial and frictional components contributing to the instantaneous total potential drop.

This paper summarizes results of investigations in the M I T Unsteady Flow Water Tunnel of accelerated and decelerated flow through uniform conduits and orifices in conduits. In the uniform conduit, shear and turbulence is generated through boundary-layer friction and is essentially uniform along the duct. Orifices cause separation and jet formation with accompanying high shear and turbulence which varies along the duct as the jet diffuses and the turbulence is dissipated. *ASME paper No. 55-SA-78.*

Discharge measurements at low Reynolds numbers—special devices. *By A L Jorissen, Cornell University.*

Utilization of constant-area differential types of fluid meters is in many cases limited to conditions for which the coefficient of discharge may be considered as practically independent of Reynolds number. This is true for orifices, nozzles, and venturi tubes.

Under a certain value of Reynolds number, coefficient of discharge exhibits a variable trend. Discharge may then only be computed by a method of successive approximations. Furthermore, experimental evidence shows that accuracy of the device is generally lowered.

Since accurate measurement of discharge at low Reynolds numbers is important in many cases (oils, various solutions, gases containing a large amount of hydrogen, hot gases, gases at low pressure), the two-fold problem has arisen of investigating behavior of standard devices at low Reynolds numbers and of studying new types of devices, more suitable for measurement of fluid flow to Reynolds numbers as low as possible. To this end, numerous investigations have attempted to develop new types of differential fluid meters in which, by compensation of the effects of contraction and friction, a constant value of the coefficient of discharge can be held at low Reynolds numbers.

As a result of the author's study of this problem, it is concluded that a number of devices offer distinct possibilities of maintaining a constant coefficient of discharge down to low values

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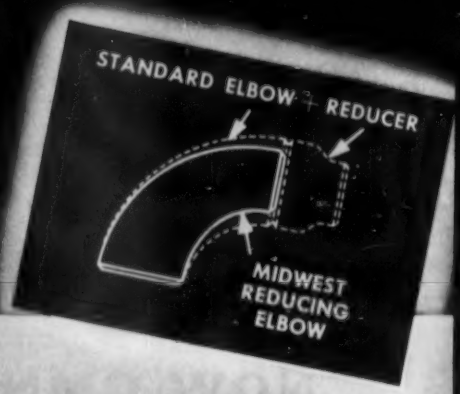
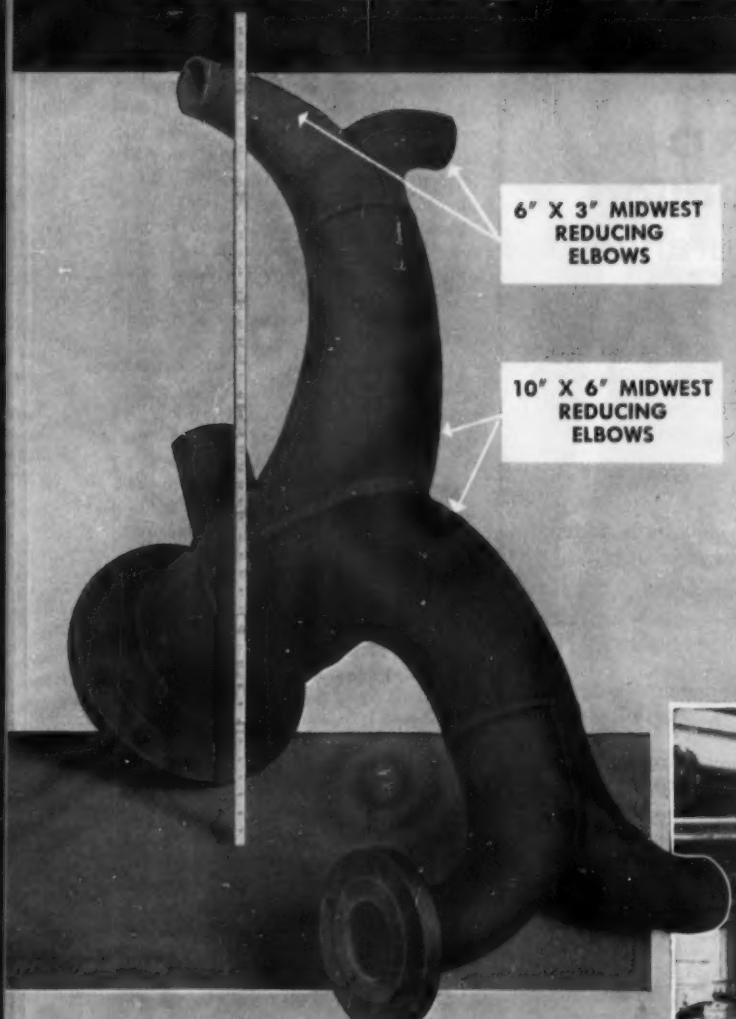
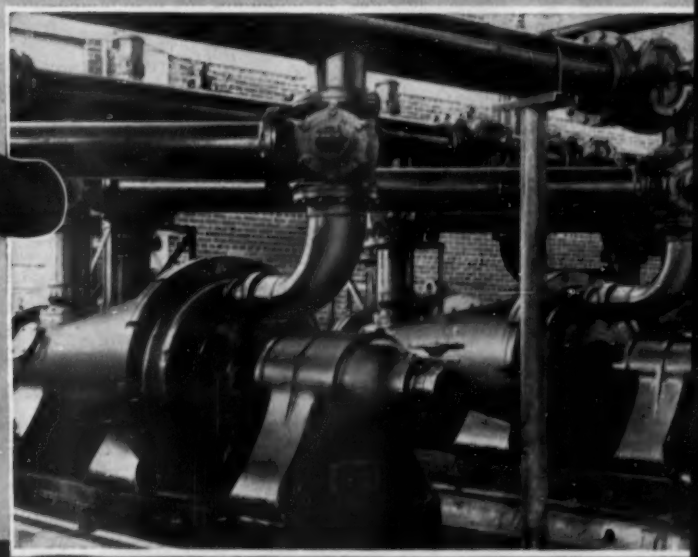




The Midwest Reducing Elbow offers important advantages in both piping design and piping cost. It needs only two welds instead of the three required by a standard elbow and a reducer (see sketch above). There is also a saving in layout time. Turbulence and pressure drop are reduced by the gradual taper . . . less space is needed . . . insulation is easier . . . and piping appearance is improved.

Only Midwest Reducing Elbows are available from stock in sizes to 16" . . . larger on special order. They have the same dimensional accuracy, uniformity of wall thickness, exact included angle and true center-to-end dimensions of Midwest Straight Elbows. For further information, ask for Catalog 54.

Midwest Reducing Elbows made it possible to fabricate this transformation piece for a boiler feed suction line so that it could be installed in the limited space available and still get the benefit of streamline flow. There was also a cost saving in comparison with a less efficient and bulky assembly made with straight tees, ells and reducers.



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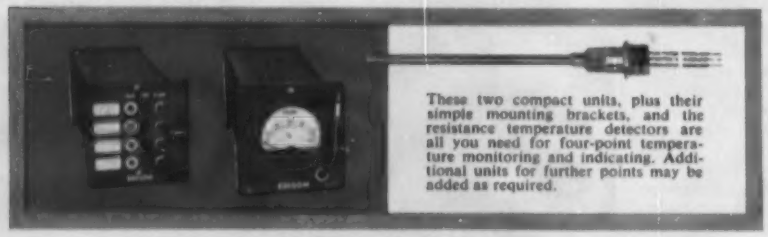

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More TECHNICAL BRIEFS

Begins on page 154

of Reynolds number. Particularly noteworthy, in the author's opinion, are the quarter-round orifice and the cylindrical nozzle with or without conical diffuser. For both, experimental evidence is available as proof of their satisfactory operation. *ASME paper no. 54-A-190.*

Flow of saturated boiler water through knife-edge orifices in series. *By E S Monroe, Jr, Cornell University.*

An equation is presented as a useful empirical relationship for flow of saturated boiler water through orifices arranged in series. It is correct only at final discharge-pressure values of atmospheric pressure but may be used as an approximation where deviation is not too great. Effect of solids in the water appears negligible, there being no discernible variation between use of distilled water and water of 3320-ppm methyl-orange alkalinity.

The type of thin-plate orifice used also appears negligible since all types gave comparable results. It is felt by the author that flashing phenomenon is a far more important controlling feature than variations in the orifice discharge coefficient. Stable flow conditions are reached between expansions quickly. In the experimentation, variation of distance travelled by the fluid from 6 in. to 14 ft did not affect flow rate.

Choice of the number of orifices to use in series must be determined by conditions other than flow rates or pressure drop. Effect on flow of using more than two orifices in series soon becomes negligible as more orifices are added. From the viewpoint of flow control, two orifices seem a practical maximum but erosion studies should be made before any conclusions are reached.

It appears there is room for extensive research and analysis on the entire problem. Further attempts to derive equations that will satisfy any pressure range and erosion studies are both a much-needed objective for the future. *ASME paper No. 54-A-118.*

Bearings

The effect of bearings on the dynamics of overhung turbines. *By C J Maday, Rossford Ordnance Depot.*

Critical speed for a rotating machine usually is calculated only from mass-elastic characteristics of the system. However, forces that will cause failure of overhung turbine bearings may be produced at steady operating speeds that are considerably below this calcu-

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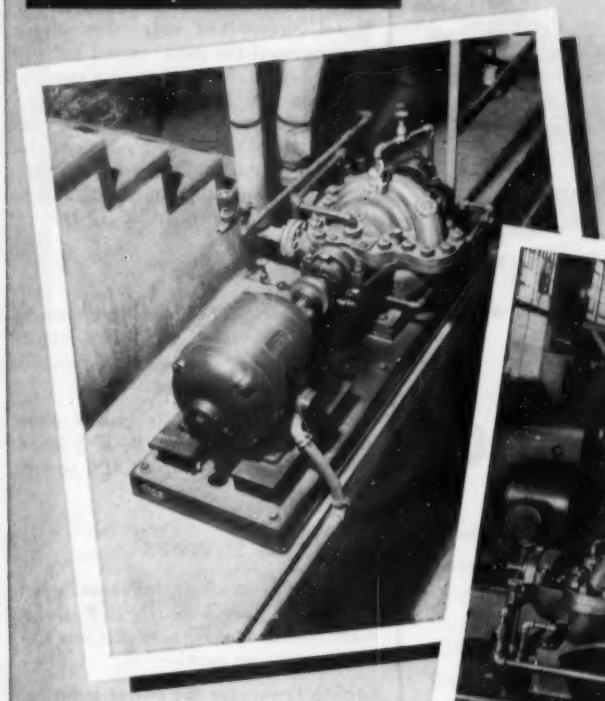
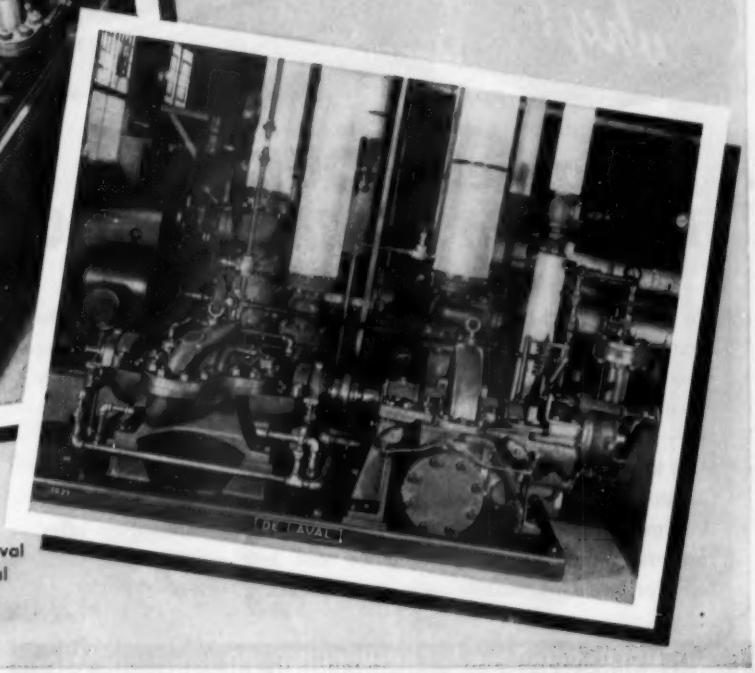
DE LAVAL
TWO-STAGE HORIZONTAL PUMPS

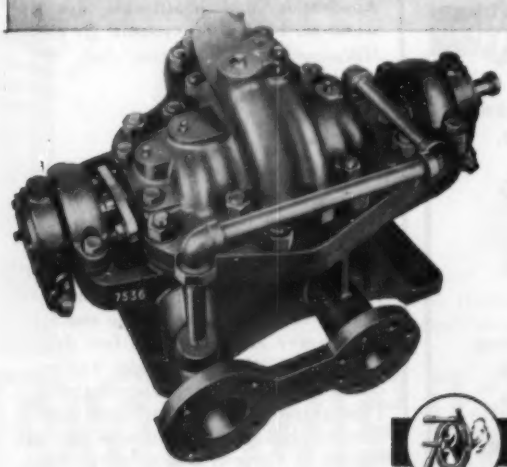
for dependable boiler feed service in institutions . . . industrial plants



Institutions can't afford shutdowns. In this hospital installation a motor-driven 21S boiler feed pump provides year-in, year-out dependability. It delivers 70 gpm of 240° water at 420 ft. head.



Industrial plants, too, choose reliable De Laval pumps for boiler feed service. This De Laval unit, driven by a De Laval turbine, delivers 160 gpm of 215° water at 520 ft. head.



There are good reasons why De Laval 21S-2KS two-stage horizontal split case pumps give long, economical boiler feed service. They are designed with • back-to-back impellers for balanced hydraulic thrust • easily replaceable threaded impeller wearing rings • long life labyrinth case rings • ring oiled ball bearings — plus ten other important design features.

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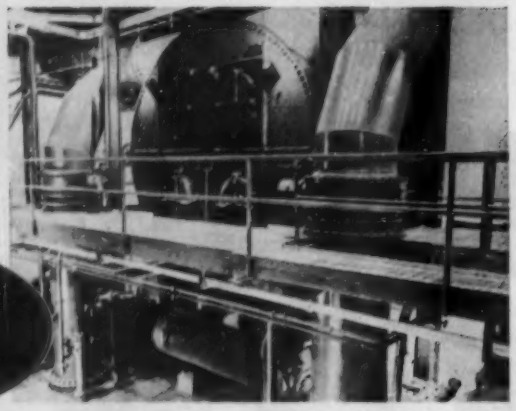

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More TECHNICAL BRIEFS

Begins on page 154

lated critical speed. Operating speed can be increased and vibration decreased mainly by decreasing bearing clearance and improving wheel balance.

These modifications also result in reduced bearing reactions and increased minimum oil-film thickness in the bearing. Performance curves computed for an overhung turbine show that critical speed, determined only from elastic properties of the rotor, cannot be used to predict maximum operating speed of the machine. Bearing eccentricity ratio, minimum oil film thickness, and magnitude of the bearing reactions also must be considered in determining maximum safe operating speed of the turbine. *ASME paper No. 55-SA-16.*

Power plants

Dynamic behavior of power plant stacks under wind loading. *By C G Merriman and M S Ozker, The Detroit Edison Co. APC paper; no number.*

Foundation problems in power plant design and construction. *By W S Housel, University of Michigan. APC paper; no number.*

Cooling towers

Cooling towers—their influence upon prospective plant sites. *By R W Gausmann, Indianapolis Power & Light Co. APC paper; no number.*

Cooling towers for the power industry. *By F J Lockhart, J M Whitesell and A C Catland Jr, The Fluor Corporation, Ltd. APC paper; no number.*

Heat pumps

Application and practicable use of water for heat-pump systems. *By C W Millsom, Acme Industries, Inc. APC paper; no number.*

Fuels

The combustion of liquid-fuel spray. *By Jax A Bolt, and Thomas A Boyle, University of Michigan.*

This paper is concerned with evaporation and combustion of liquid-fuel spray in the range of sizes predominantly used in aircraft gas-turbine combustors. Spray of uniform-size fuel drops of 70 to 130 microns diameter was produced by means of a spinning disk. Photographic techniques were developed to obtain an indication of rate of change of diameter and velocity of the

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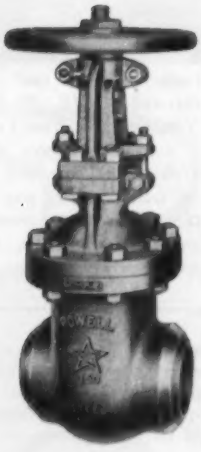

FIG. 1503WE—150-Pound Steel Gate Valve.

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

FIG. 19003—900-Pound Steel Pressure Seal Gate Valve.

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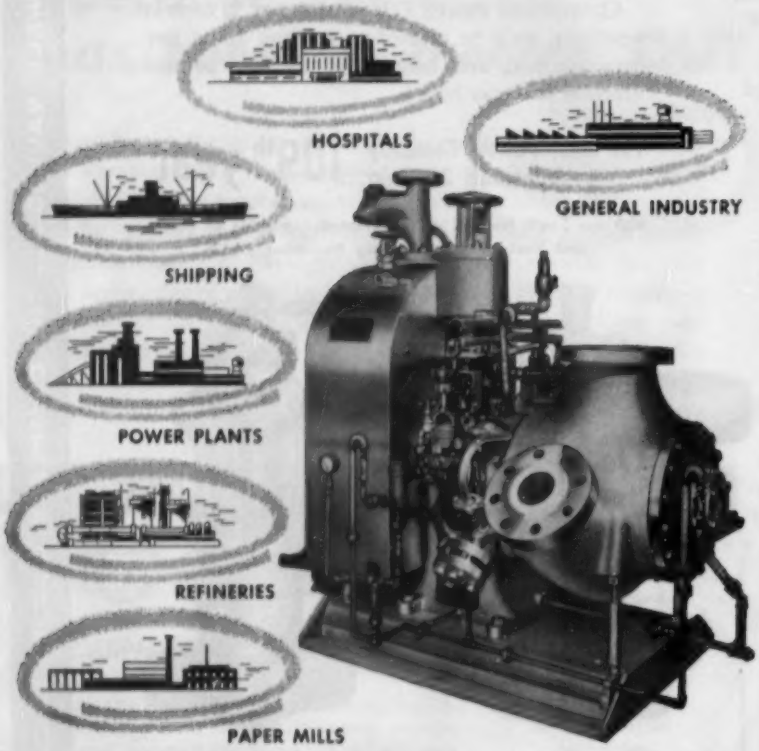

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Begins on page 154

burning drops, while moving freely in air. Rates of burning for several pure hydrocarbon fuels were determined. Experimental work accomplished emphasizes complexity of the combustion of a fuel spray, and need for much additional work. *ASME paper No. 55-SA-67.*

Generation and use of sewage sludge gas in municipal sanitation. *By R A Hoot, Sanitary Engineer, City of Philadelphia, Philadelphia, Pa.*

Sewage gas is a source of considerable potential energy. It has been reliably estimated that if all energy contained in America's sewage could be captured, it would provide sufficient power to run a half-million horsepower engine continuously. While this is a meager amount of energy compared with power that could be obtained by harnessing the tides at Passamoquoddy or the power available from Norris Dam, still it is something worth considering. In this paper, the author explains how sewage is treated in the U. S. and how one of the main products of that treatment, sewage gas, is generated and used. *ASME paper No. 55-S-8.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Power Conference, 17th annual meeting. Identified by initials APC and obtainable through purchase from R A Budenholzer, chairman, Illinois Institute of Technology.

More than $8-million will be spent for construction of new substations or enlargement of those now in service in Mexico City, officials of the Mexican Power and Light Co have announced.

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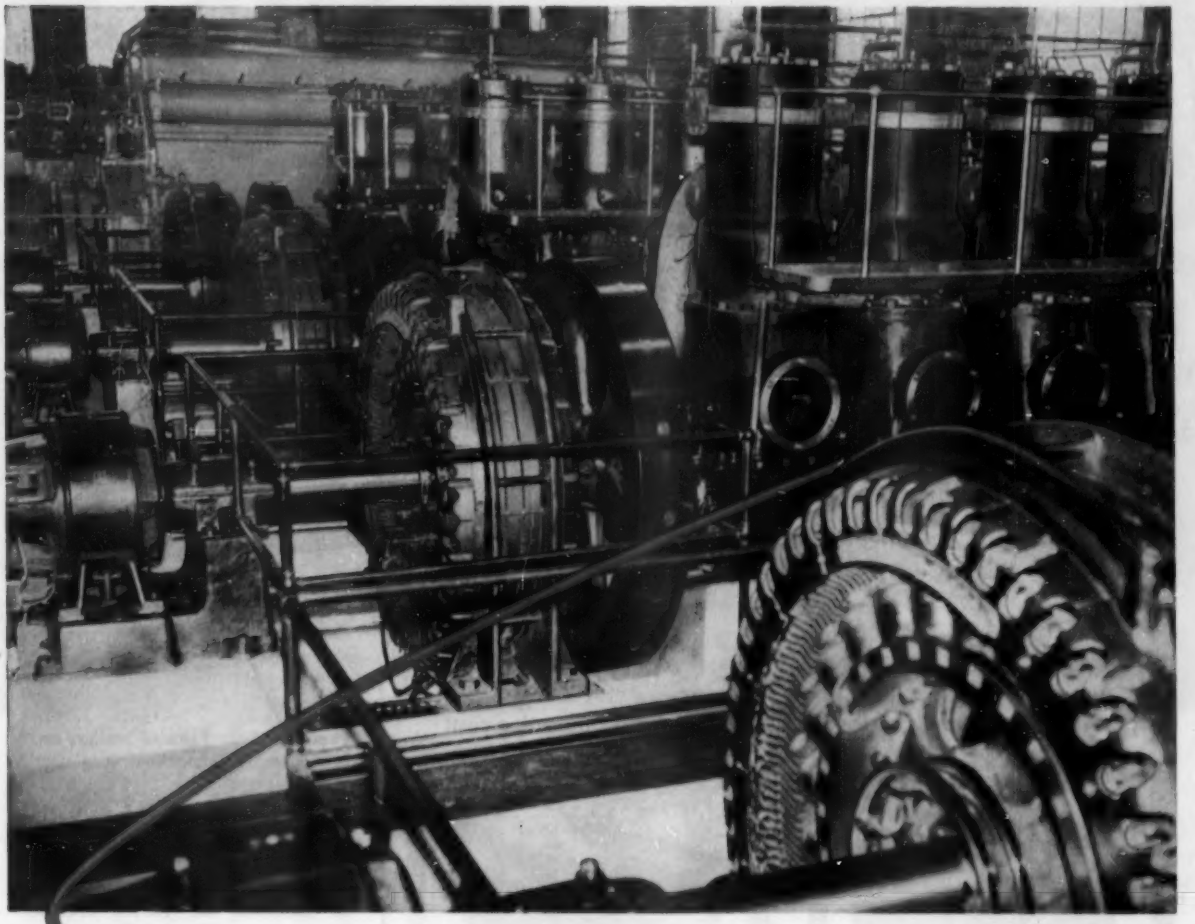

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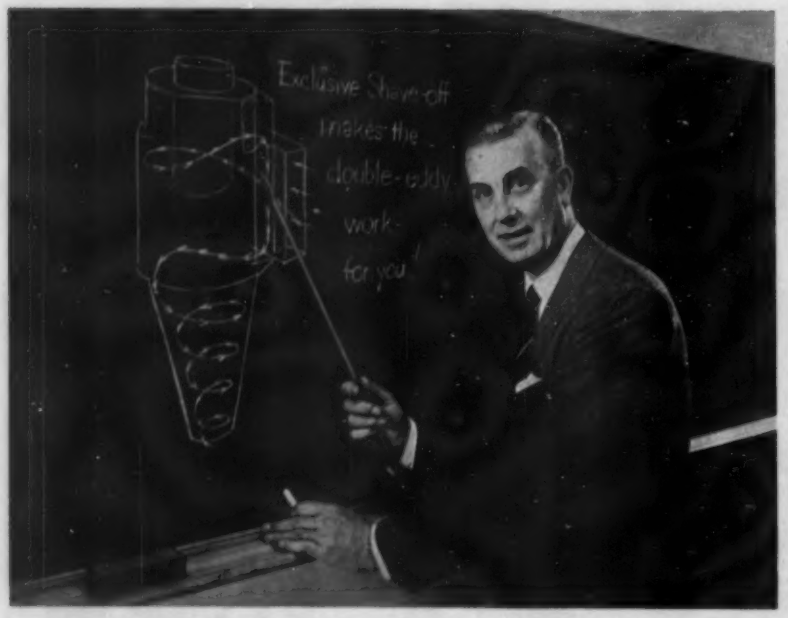

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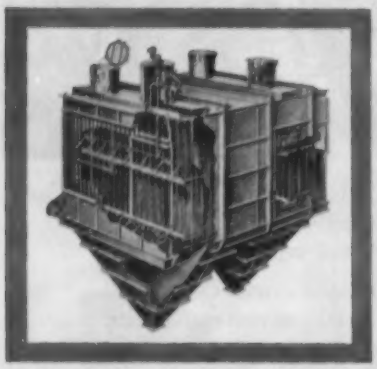

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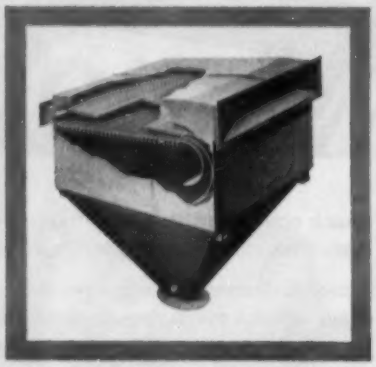

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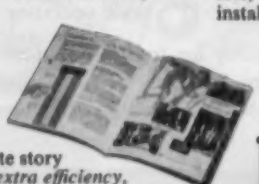

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APPOINTMENTS

Corporation executive changes

The Cooper-Bessemer Corp: Lawrence F Williams, president. **Kuhlman Electric Co:** George R Fluehr, president; H E Greenwalt, executive vice-president. **Alloy Steel Products Co, Inc:** Raymond M Davis, president. **Colson Corp:** Norman A Price, vice-president and director. **National Carbon Co,** a div of Union Carbide and Carbon Corp: Clarence E Larson, vice-president, research. **Minneapolis-Honeywell Regulator Co,** Brown Instrument Div: C L Peterson, vice-president and general manager. **Baldwin-Lima-Hamilton Corp:** Robert B Murray Jr, vice-president and director; James M White, vice-president, manufacturing; John R Martin, vice-president, electronics and instrumentation operations.

Operations executive changes

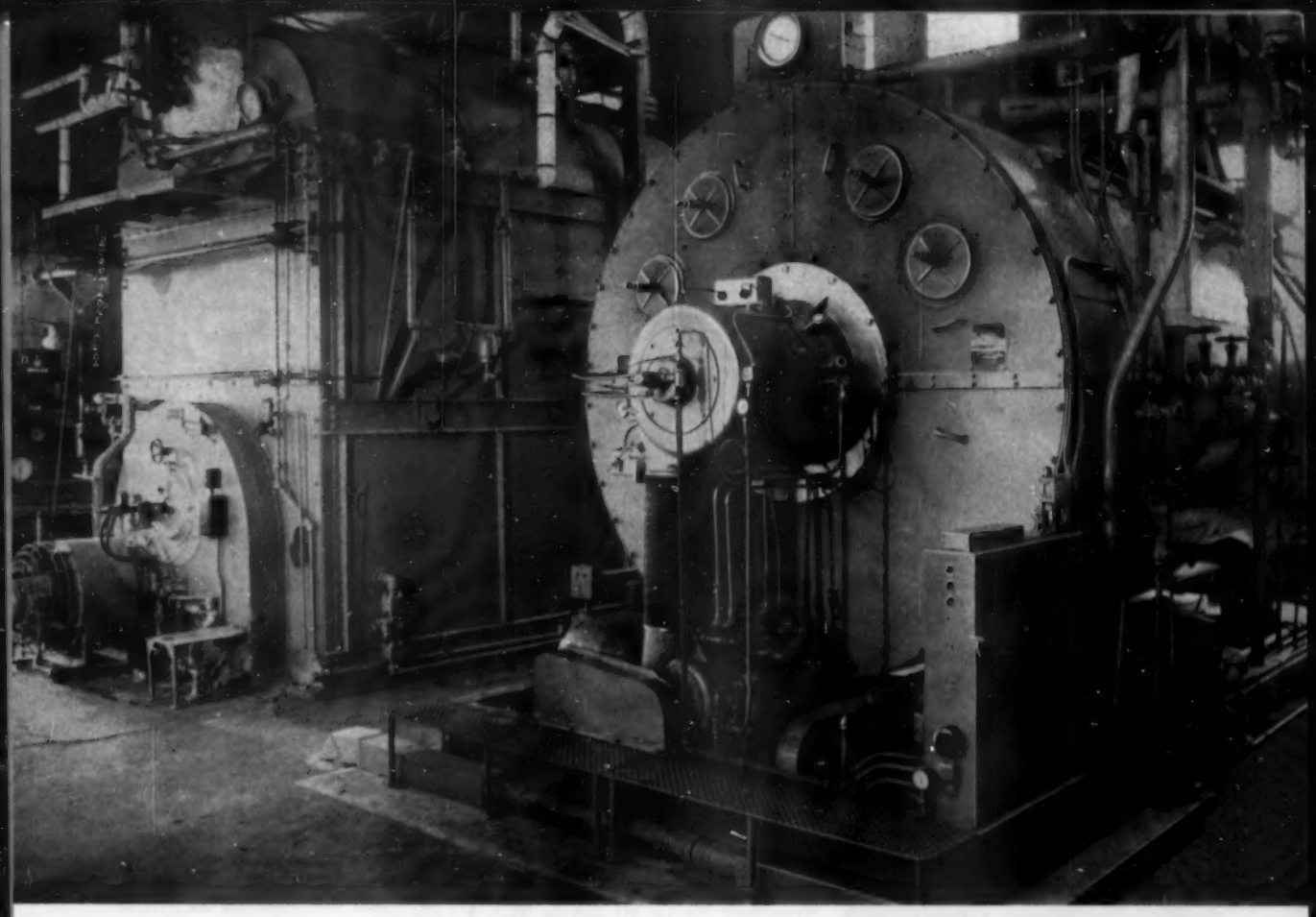
Westinghouse Electric Corp: Carroll V Roseberry, manager of newly-formed commercial atomic power activities; William E Shoupp, technical director, commercial atomic power activities. **Los Angeles City,** Dept of Water and Power: William S Peterson, general manager and chief engineer. **The Kuljian Corp:** Frank B Warren, general office manager. **Sylvania Electric Products Inc:** Leonard Smiley, manager of technical coordination in atomic energy division.

New sales managers

J A Zurn Mfg Co: John Patrick Tansey, manager of engineering sales for industrial and marine divisions. **Westinghouse Electric Corp:** Louis Martin, electronic tube division. **Brown Fintube Co:** J B Carpenter, boiler division. **Minnesota Rubber and Gasket Co:** Richard G Wells, general sales. **Harbison-Walker Refractories Co:** Richard S Moore, general sales. **Chain Belt Co:** George H Woodland, general sales, industrial divs. **Metal & Thermit Corp:** H D McLeese, general sales. **H K Porter Co, Inc,** Alloy Metal Wire div: Roy Barbier, Detroit district. **B-I-F Industries, Inc:** M H Strickland, industrial sales, Chicago district.

Worthington Corp: William J Davies, Cleveland district. **The Foxboro Co:** H O Ehrisman, general sales; J J Burnett, field sales; H H Michelmore, New England district; E R Huckman, New York; J B Deaderick, Philadelphia; A H Shafer, Pittsburgh; E W Prendergast, Atlanta; H L Lee, Cleveland; J J Connelly, Chicago; E L Stark, Dallas; L W Parten, Houston; and R E Rogers, San Francisco.

U.S. Rubber Co, mechanical goods div: Carl E Bellew, molded and extruded products. **Raybestos-Manhattan, Inc,** rubber and packing divs:



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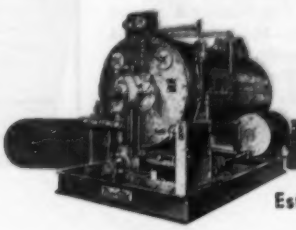

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Cleveland 10, Ohio

More APPOINTMENTS

Begins on page 224

Bruce W Thomas, Eastern district. **The Cooper-Bessemer Corp:** George W Edick, branch manager of compressor and stationary engine sales in New York City.

New sales engineers

The Trane Co: Joseph Wait, Washington, D.C. office. **R P Adams Co, Inc:** John T Sacha, home office at Buffalo, N. Y. **The New York Air Brake Co;** Aurora Pump Division: Charles S Quillen, New Jersey territory. **Blaw-Knox Co;** National Alloy Division: Frederick L Feldmeth, Philadelphia office. **T R Finn & Co, Inc:** Edwin L Keil, New York City area. **Simplex Valve & Meter Co:** Hugh J McNelis, Chicago office. **Barber-Colman Co;** Wheelco Instruments Division: William Bohrer, Cleveland office.

New distributors

For **Stephens-Adamson Mfg Co,** Standard Products Division: Eastern Engineering Sales Co, 33 Allerton, Roxbury 9, Mass.; Stephens-Adamson Mfg Co, 2227 E 37th St, Los Angeles 58, Calif.; Linder, Cox & Co, 109 Allamanda Dr, Lakeland, Fla.; S-A Products Co, 145 Mission St, San Francisco 5, Calif.; Langdon Supply Co, 1317-19 Union Ave, Kansas City 7, Mo. and Strong-Scott Mfg Co, 451 Taft St, NE, Minneapolis 13, Minn.

For **The Johnson-March Corp:** Acme Engineering Agency, Indianapolis, Ind.; J H Ballenger, Cincinnati, Ohio; The Dorner Co, Milwaukee, Wis.; Charles A Herron, Birmingham, Ala.; Victor H Jones Co, Chicago, Ill.; Linder, Cox & Co, Lakeland, Fla.; Ralph E Little, Davenport, Iowa; Charles T Nevins, Narberth, Pa.; Osgood & Associates, Atlanta, Ga.; Power Equipment Sales Co, Boston, Mass.; The Power Specialty Co, Nashville, Tenn.; The Rhodes Equipment Co, St Louis, Mo.; Stanley B Troyer Equipment Co, Crosby, Minn.; United Equipment Co, Columbus, Ohio and Western Ohio Ventilating Co, Toledo, Ohio.

For **The V D Anderson Co:** Yocum and Goode, Inc, Graybar Bldg, New York 17, N. Y. For **Cummins Engine Co, Inc:** Cummins Diesel Michigan, Inc, 3601 Gratiot Ave, Detroit, Mich.

New representatives

For **Continental Foundry & Machine Co,** Copes-Vulcan Division: Dickey Engineering, 2721 Central Ave, NW, Knoxville, Tenn. For **J F Pritchard & Co:** Tate Engineering & Supply Co, Inc, Baltimore, Md, and Cone and Wallace Co, Phoenix, Ariz.

For **Graver Water Conditioning Co:** Edward G Moninger Co, 504 Plymouth Bldg, Minneapolis 3, Minn. For **A W Cash Co:** The David J Rank Co, 307 Columbia Bldg, Louisville, Ky;

Get All The Advantages With Ferri-Floc

You can depend on Ferri-Floc to give smoother, more efficient and trouble-free coagulation. Whatever your specific water treatment problem may be, you can depend on Ferri-Floc to do the job adequately, efficiently and economically. Ferri-Floc is a free-flowing granular salt which can be fed with a few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy and safe handling as well as storage in closed hoppers over longer periods of time.

WATER TREATMENT

Ferri-Floc coagulates surface or well waters, and it aids taste and oder control. It is effective in lime soda-ash softening, and is adaptable to treatment of practically all industrial water or wastes.

SEWAGE TREATMENT

Ferri-Floc coagulates waters and wastes over wide pH ranges. It provides efficient operation regardless of rapid variations of raw sewage, and is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

SULFUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

SULFUR-DIOXIDE SO_2

COPPER SULFATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

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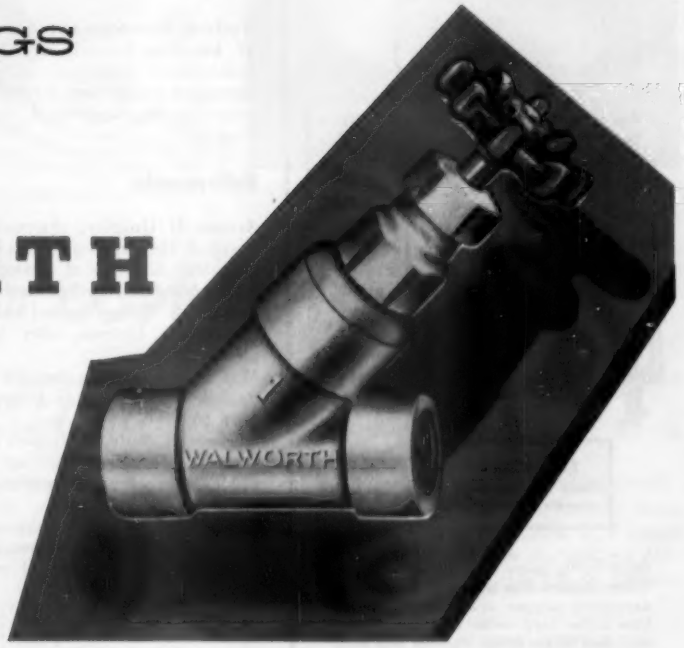
PLASTIC

VALVES and PIPE FITTINGS

by

WALWORTH



These new corrosion-resistant valves and pipe fittings are molded of rigid polyvinyl chloride. They round out complete lines of Walworth Valves and Fittings of Steel, Stainless Steel, Bronze, Iron, and Special Alloys. A brochure explaining the complete Walworth PVC product story has been prepared for your information. Just send us your name and address. *Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.*

Stop Corrosion

in boilers, steam and return lines . . .

with this Stickle deaerating feed water heater

SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

FREE CATALOGS!

S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment
Cuts the cost of steam

More APPOINTMENTS

Begins on page 224

Bert Gurney & Associates, 1112½ Farnam St, Omaha, Nebr. and Consolidated Engineering Sales Co, 205 E 6th St, Cincinnati, Ohio. For **Ross Operating Valve Co:** Hydraulic & Air Equipment Co, 2316 NW Savier St, Portland, Ore, and at 2348 Alki Ave, Seattle, Wash.

New sales offices

Philadelphia Gear Works: at 1900 Euclid Ave, Cleveland 15, Ohio, W K Kozel, manager; and at 1529 Pentridge Rd, Baltimore 12, Md, J Frank Ottinger, manager. **Bell & Gossett Co:** at 30 Huntington Ave, Boston, Mass, J A Ivester, manager. **Kieley and Mueller, Inc.:** at 95 Liberty St, New York, N. Y., Alfred W Bailey, manager. **Robertshaw-Fulton Controls Co,** Fielden Instrument Division: at 3101 Imperial Highway, Lynwood, Calif, Charles J O'Lone, manager.

New names

Nuclear Development Corporation of America, formerly named Nuclear Development Associates, Inc. **Wheelabrator Corporation,** formerly named American Wheelabrator & Equipment Corp.

Retirements

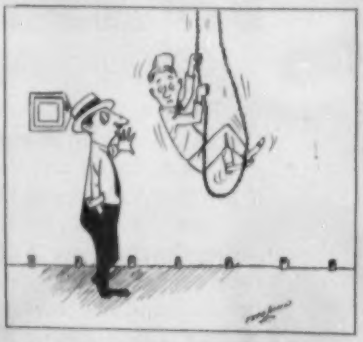
Arthur H Quigley, chairman of the board of The American Brass Co, after more than 53 years of service.

A M Kohler, vice-president of The Babcock & Wilcox Co and head of its Refractories Division, after 42 years' service.

M J Lester, district manager for The Garlock Packing Co in Denver, Colo, after 50 years of service.

Herbert H Muir, equipment sales engineer for the Mead-Morrison Division of McKiernan-Terry Corp, after 35 years of service.

John Edwards Jr, general manager of Eastern Region of the Baltimore & Ohio Railroad, after 44 years of service.



"Too bad you don't weigh 50 pounds more. You could pull the stem right off of that valve."

what's YOUR water problem?

Why waste time and money on periodic shut-downs for cleaning? Let your MOGUL SERVICE MAN help solve your water problems.

There's a MOGUL solution for every water condition and problem.

MOGUL offers a completely integrated water treatment program and results are guaranteed.

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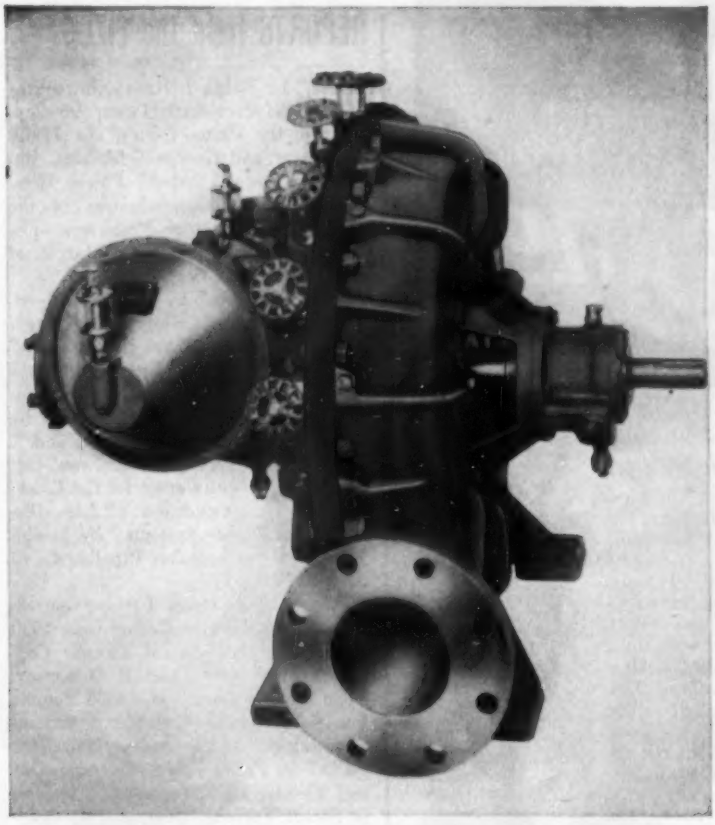

This is the reliable Coppus Turbine furnished with either type of wheel

Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

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Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

ELGIN ALONE

can offer the exclusive

ULTRA-DEIONIZER

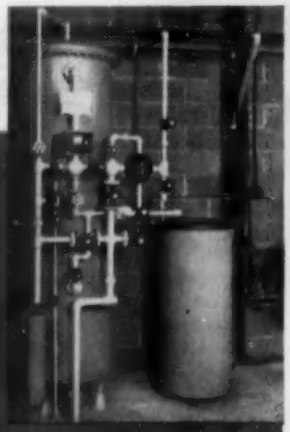
featuring the famous "Double-Check" manifold*

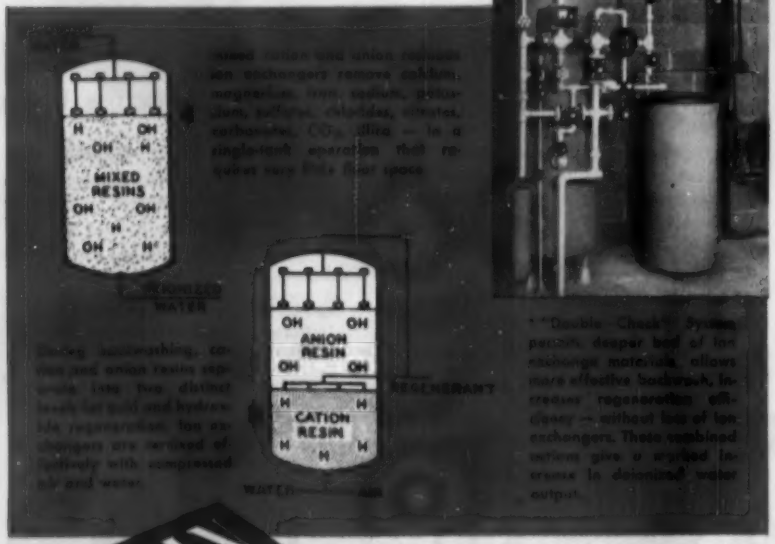
Boiler feed or process water of highest chemical purity for a small fraction of the cost of distilled water!

For boiler feed or process water of matchless chemical purity, you can *depend* on Elgin's Ultra-Deionizer, the single-tank, monobed unit that removes all ionizable materials — positive and negative — and delivers ready-for-use water containing 1 ppm or less total dissolved solids! With water of such superior quality, it is obvious that costly equipment is less subject to damage through impurities, shutdown time is reduced to a minimum . . . and with these added advantages, the Ultra-Deionizer provides perfect water at costs often *as low as 18c per 1000 gallons!* Distilled water — with as much as 10 ppm total dissolved solids — costs many times more!

And *only* the Ultra-Deionizer is equipped with the exclusive, patented "Double-Check" upper manifold . . . the system which permits better, more effective backwashing, more efficient regeneration *without loss of costly ion exchange materials.*

For complete details about the Elgin Ultra-Deionizer, write for Bulletin No. 512 — or ask your Elgin representative to show you how an Elgin Ultra-Deionizer can save money for *your* plant.





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Economical WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION

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In Canada: G. F. Sterne & Sons Ltd., Brantford

REPORTS from the FIELD

Begins on page 152

States," by Ralph L Brown, Bureau of Mines. "Hydroelectric Power Development in the United States," by Frank L Weaver and George G Adkins, Bureau of Power, Federal Power Commission. "The Determination of the Hydroelectric Energy Resources of a River Basin," by J R Riter, Bureau of Reclamation.

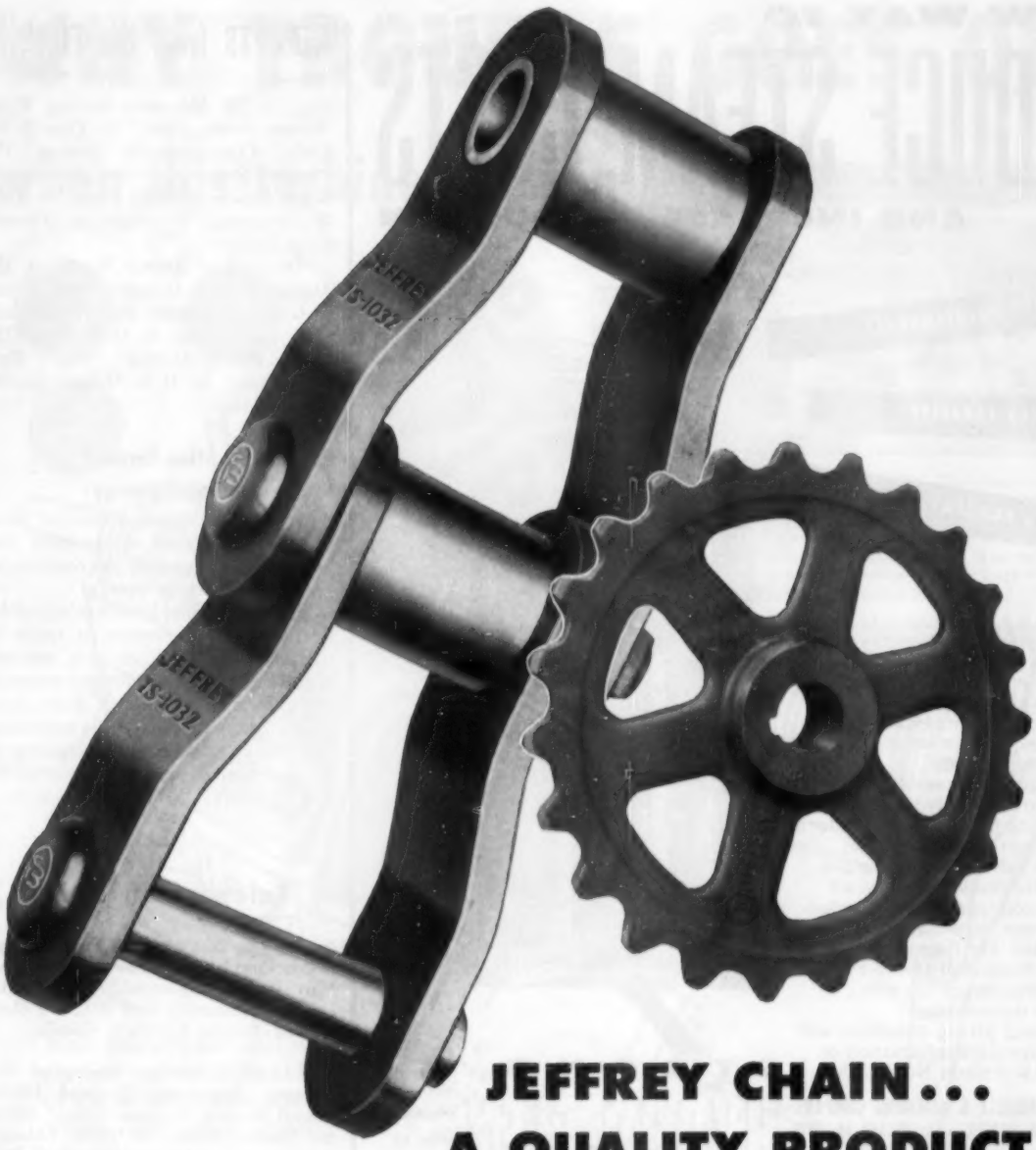
"Atomic Fuels," by Dr Frank Spedding, Iowa State College. "The Preparation and Treatment of Liquid Fuels," by E B Reeves, Esso Engineering and Research Co. "Natural Gas as an Energy Source in the United States," by George G Oberfell, Consultant, and T W Legatski, Phillips Petroleum Co. "Economic Requirements for the Establishment and Operation of Long-Distance Gas Supply Systems," by Joseph J Hedrick, Natural Gas Pipeline Co of America.

"Progress in Steam Turbine-Generator and Gas Turbine Design from 1950 to 1955 by the General Electric Co," by Carl Schabatch and H D Kelsey. "The Development of the 4500 Pounds Per Square Inch Multiple Superheat Supercritical Generating Unit for Philo," by Philip Sporn, American Gas and Electric Co. "Technical Advances in Steam Turbine - Generator Design," by J R Carlson and A M Harrison, Westinghouse Electric Corp.

"Technical Advances in Steam Turbine - Generator Units, Allis - Chalmers Mfg Co," by C D Wilson and L T Rosenberg. "Technical Advances in Steam Boiler Design, the Babcock & Wilcox Co," by W H Rowland and George Kessler. "American Steam Power, 1950-1955," by J N Landis, Bechtel Corp. "Technical Advances in Steam Generator Design, Combustion Engineering, Inc," by Otto de Lorenzi. "Big Creek Hydro Development," by James F Davenport, Southern California Edison Co. "Hydroelectric Power in Multiple-Purpose Water Resource Develpment Programs," by Charles W Kinney, Corps of Engineers.

"Status of Nuclear Power Technology," by W Kenneth Davis, Atomic Energy Commission. "Economics of Nuclear Power," by U M Staebler, Atomic Energy Commission. "The Proposed Consolidated Edison Company of New York Nuclear Power Plant," by Gordon R Milne, Consolidated Edison Co of New York, and John W Landis, Babcock & Wilcox Co. "Economic Considerations Involved in the First Power Reactor for New England," by R Leigh Fitzgerald, New England Electric System.

"A Large Fast Neutron Breeder Reactor Power Plant," by Walker L Cisler and Arthur S Griswold, Detroit Edison



JEFFREY CHAIN... A QUALITY PRODUCT

"Don't let the work-horse appearance of chain fool you", said an important buyer of power transmission equipment. "Chain is a precision product. And Jeffrey gives us that precision."

In the manufacture of Jeffrey Chain and Sprockets, metals get prime consideration; steel, bronze, malleable iron and stainless are carefully selected for each chain and sprocket requirement. Machining, heat treatment, assembly and inspection are accurately controlled to insure that these products meet Jeffrey's high quality standards.

Jeffrey Chain is designed for maximum strength with minimum weight. Jeffrey Sprockets and Chain make an excellent combination, giving full bearing contact without play or binding. They assure most efficient use of power and long life for power transmission and conveying equipment.

Chain engineers in Jeffrey district offices are on call to help you specify this quality chain which is normally available from distributor or factory stocks. For further information, write to The Jeffrey Manufacturing Co., Columbus 16, Ohio.

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NEW WAY TO

REDUCE STEAM COSTS

AND INCREASE PRODUCTION

☐ Here is a new steam trap that meets all operating conditions!

The Strong Hydro-Flex Steam Trap performs efficiently under light loads yet gives the same high standard of performance under heavy flow, also greater discharge capacity when needed.

We guarantee your steam system will improve with Hydro-Flex. Outstanding plus-features include: a dual fulcrum arrangement that snaps the valve wide open to give unrestricted condensate flow, all stainless steel working parts including one piece deep-drawn stainless steel bucket. The rugged construction features of Hydro-Flex provide long service life with minimum maintenance.

Your local Strong distributor will give you complete information or write us for Bulletin No. SS-40.

STRONG, CARLISLE & HAMMOND COMPANY
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STRONG HYDRO-FLEX STEAM TRAPS — high efficiency under all condensate loads

HORIZONTAL TYPE SERIES
Hydro-Flex traps with horizontal inlet have the same features as bottom inlet types.

Available from over 200 industrial distributors in the United States, Canada and Foreign Countries.

3 types available for wide range application . . . to meet pressure and capacity requirements.

PRESSURE REGULATING VALVES

are custom sized for job demands. Bolted body permits non-threaded seats and wide selection of seat sizes.

BLOW-DOWN VALVES

STRONG STRAINERS
Offer maximum protection from dirt, scale or sediment. Available in semi steel, cast steel and bronze.

REPORTS from the FIELD

Begins on page 152

Co. "A 180 Megawatt Boiling Water Reactor Power Plant," by Titus G LeClair, Commonwealth Edison Co. "Status Report on the Pressurized Water Reactor (PWR) Plant," by John W Simpson, Westinghouse Electric Corp.

"Disposal of Atomic Wastes in the Atomic Energy Industry," by Arthur E Gorman, Atomic Energy Commission, and Gordon E McCallum, U.S. Public Health Service. "Power Pool Operations," by H L Melvin, Ebasco Services, Inc.

New corporation formed to develop solar energy

► A NEW ENTERPRISE, known as Solar Energy Corporation of America, has been formed to explore the commercial possibilities of solar energy.

Where warranted by technological developments, the company is ready to risk capital in any likely area, whether in the U.S. or abroad. Beyond commercial aspects in exploitation of the sun's power, is a realization by its organizers that the corporation is participating in the evolution of a new and potentially great industry.

Calendar of Events

Nov 8-11—Institute of Power Engineers, Canada's 1955 Power Show. Show Mart Building, Montreal. Complete information obtainable from IPE, 410 Bloor St, East, Toronto 5, Ontario, Canada.

Nov 13-18—American Society of Mechanical Engineers, Diamond Jubilee Annual Meeting. Congress, Conrad Hilton and Sheraton-Blackstone Hotels, Chicago. Full information from ASME, 29 W 39th St, New York 18, N. Y.

Nov 14-18—American Society of Mechanical Engineers, Chicago Exposition of Power and Mechanical Engineering. Chicago Coliseum. Details from ASME, 29 W 39th St, New York 18, N. Y.

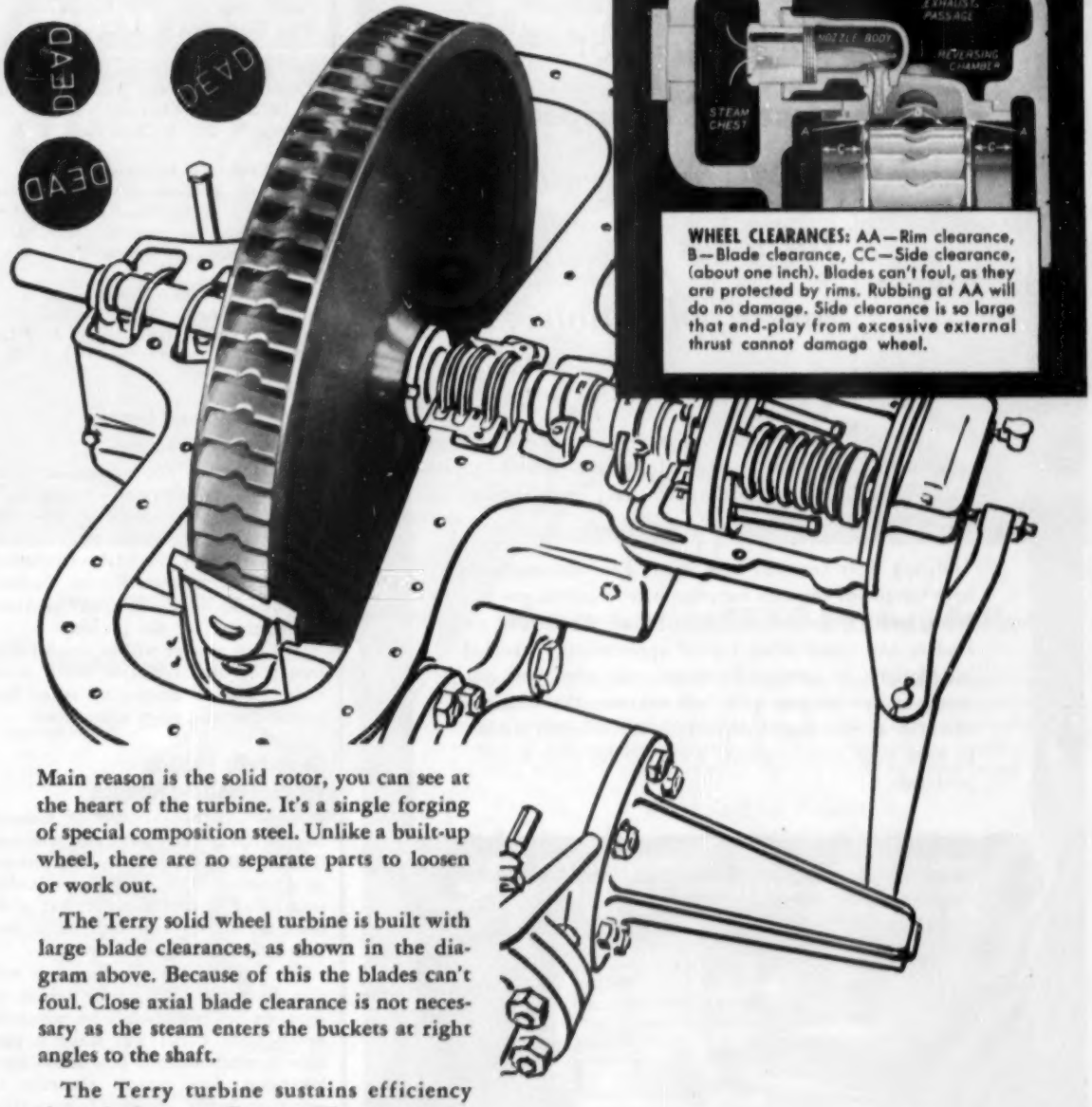
Nov 14-17—Second International Automation Exposition, Navy Pier, Chicago. Details from Richard Rimbach Associates, Inc, 845 Ridge Ave, Pittsburgh 12, Pa.

Nov 16-18—Steel Founders' Society of America, 10th Annual Technical and Operating Conference. Hotel Carter, Cleveland. Details from SFSA, 920 Midland Building, Cleveland 15, Ohio.

Nov 16-18—Society for Experimental Stress Analysis, 1955 Annual Meeting. Sheraton Hotel, Chicago. Full informa-

WHY TROUBLE GOES OUT

when this turbine goes in



WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

Bulletin S-116 tells more about these *"Work Horses of Industry."* Send for a copy today.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1202

PEABODY

the pioneer of

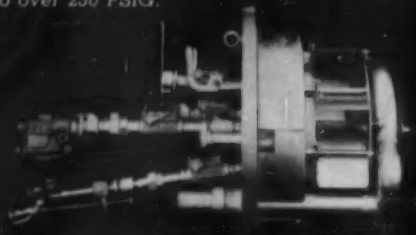
combustion equipment

for firing pressurized furnaces for any application...

For more than 25 years, Peabody Burners have been successfully used for firing pressurized furnaces on hundreds of critical combustion jobs throughout the world.

Utilizing their years of experience, Peabody engineers have developed burners for pressurized boilers, gas turbines, inert gas generators, high pressure direct-fired air heaters and many other typical applications. Repeated installations, in varying locations, year after year, for many, many clients are your best assurance that Peabody can offer an economical, dependable and efficient product to meet your requirements. We welcome your specific problems.

Peabody burners are used on a wide variety of installations firing into furnaces ranging in pressures from negative to over 250 PSIG.



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REPORTS from the FIELD

Begins on page 152

tion obtained by writing W M Murray, SESA, P.O. Box 168, Cambridge 39, Mass.

Nov 28-Dec 1—Air Conditioning & Refrigeration Institute, 9th exposition of the air conditioning and refrigeration industry. Auditorium, Atlantic City, N. J. Details from ARI, 1346 Connecticut Ave, NW, Washington 6, D. C.

Dec 12-17—Engineers Joint Council, Nuclear Congress and Atomic Exposition to be held in Cleveland. Details from EJC, 29 W 39th St, New York 18, N. Y.

Jan 3-Feb 3—American Institute of Electrical Engineers, Winter General Meeting to be held in New York. Complete information obtainable from AIEE, 33 W 39th St, New York 18, N. Y.

Jan 23-26—Plant Maintenance & Engineering Show. Convention Hall, Philadelphia. Details from Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Kaiser engineers begin design of test reactor

► A TEAM OF SPECIALISTS from the Atomic Energy Division of Kaiser Engineers has begun work on designing an engineering test reactor. Contract was awarded by the Idaho Operations Office of the Atomic Energy Commission designating the company as Architect-Engineer for the project.

The new reactor will be employed in testing in high radiation fields, materials related to developing cores, fuel assemblies, and other components.

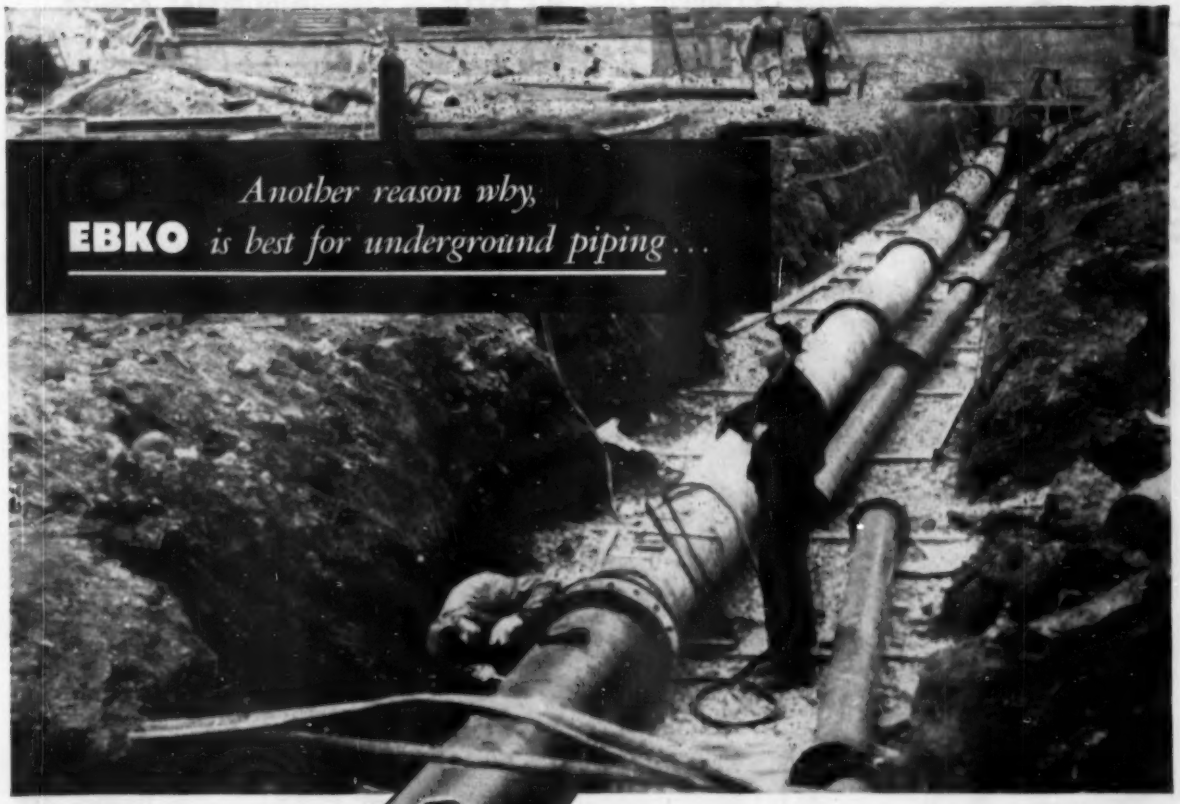
GE installs 1000-lb vacuum melting furnace

► CARBOLOY DEPARTMENT of General Electric Co recently put a new semi-continuous 1000-lb vacuum melting furnace in operation. This represents another step in alleviating metallurgical problems that have been creating a bottleneck at the designers' level.

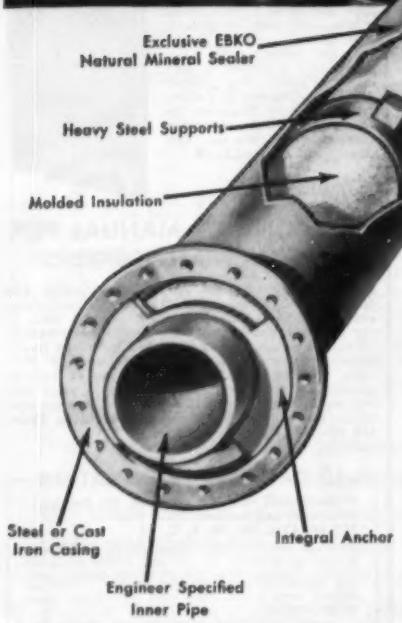
The new pilot production unit will give designers a little more leeway in selecting better materials for advanced development work; will make it possible to create entirely new alloys from lower-cost, less critical elements of equal or better structural properties than those produced by air melting.

The additional capacity will also help relieve the pressure on metallurgists who have been hindered by three basic problems associated with conventional air melting. These are (1) controlling elements like oxygen and nitrogen (2) limitations in adding alloying elements (3) problem of getting rid of dissolved gases and impurities.

For industry in general, the availabil-



Another reason why,
EBKO *is best for underground piping . . .*



Never has an EBKO System Failed!

Over 1,000 miles of EBKO piping has gone underground since the first system was installed. The durability of this prefabricated piping system has been tested by these installations and has proven worthy of full investigation prior to the purchase of any system . . . because, never, to our knowledge, has an EBKO system failed.

What Is This Reason
For The Superior Durability
Of An EBKO System?

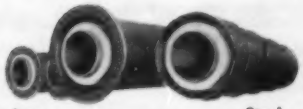
Simplicity . . . high quality component parts . . . improved design . . . inherent strength . . . and other factors add up to a system that is safe for any type soil. It can be completely submerged in water without deterioration for many, many years.

Each of the six component parts are held to the most rigid specifications. The simplicity of design allows EBKO to keep the quality high and yet keep the cost down.

This system costs no more initially than other prefabricated piping systems and saves money on installation and maintenance.

Complete details on this system may be had from local EBKO representatives or by writing to the factory—no obligation of course.

© 1955, E. B. Kaiser Co.



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Underground and Overhead Prefabricated Piping Systems

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Since 1890
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For STEAM • CONDENSATE • HIGH TEMPERATURE and CHILLED WATER • REFRIGERANTS • GASES • ETC.

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

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showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

REPORTS from the FIELD

Begins on page 152

ity of metals of longer life from the vacuum or controlled atmosphere process may mean a sizable reduction in maintenance bills caused by bearing and other failures on equipment.

Use of selenium rectifiers may present hazards

► USE OF SELENIUM RECTIFIERS in electrical circuits is growing (See "Selenium rectifiers for dc packaged power," November 1954).

The hazard of inhaling or ingesting selenium can be quite serious under certain conditions, according to a chemical hazards bulletin issued by the Association of Casualty and Surety Companies. Symptoms of acute selenium exposure include irritation of the eyes and nose, nervousness, fear, vomiting, diarrhea, respiratory difficulty and spasms of the voluntary muscles of the back. However, acute effects other than garlicky breath have not been reported from industrial exposure.

To get the manufacturers' viewpoint, POWER contacted the Rectifier Department of General Electric Co. Pertinent sections of the hazard bulletin, and of the manufacturer's comments, follow:

Hazards bulletin: The possibility of exposures to selenium . . . would be quite remote except for the increasing use of selenium rectifiers in electrical circuits. Authorities disagree as to the danger involved in burnouts of selenium rectifiers in "light service" such as television sets and radios. Latest reports seem to indicate that there is little danger from such burnouts. On the other hand exposures from burnout of "heavy duty" selenium rectifiers used in large battery chargers, aircraft energizers and high voltage electronic equipment should be guarded against.

When a burnout occurs, power should be immediately removed from the circuit and the area ventilated. Employees should avoid the locality of the rectifier until this has been done. Prevent contact between the skin and rectifier residue by using rubber gloves for handling the burned out unit.

Units should be protected by inserting the proper fuses on the ac side. Rectifiers should also be installed away from parts of the circuit that heat up, and in a vertical position so they may be cooled by natural currents.

In some cases, rectifiers are cooled by blowing air directly on them with a fan. Check fan intake frequently to prevent clogging. Keep rectifiers reasonably clean to prevent insulating them from cooling air currents.

Always be careful to keep hot solder from falling on the rectifiers. Never

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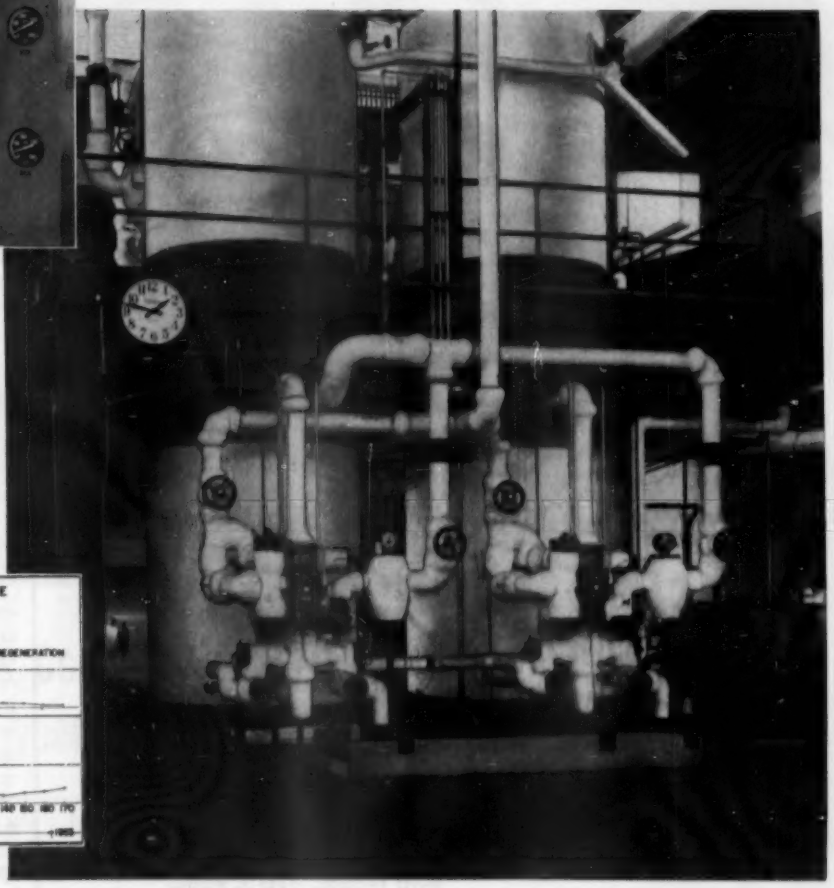
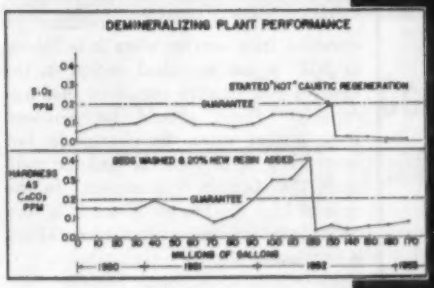


Waukegan Station Demineralization Plant

"CATEXER" "ANEXER" Demineralization Plant performance charts at Waukegan Station.



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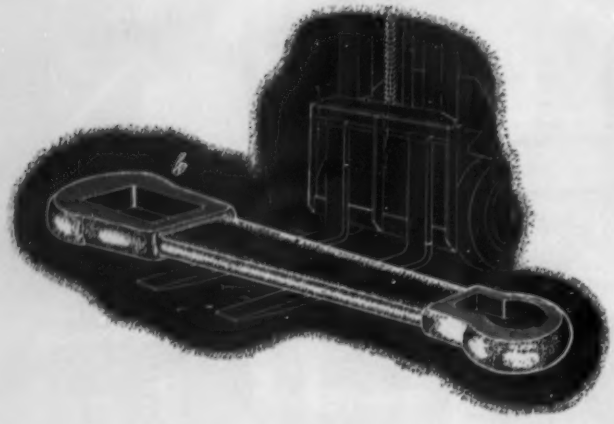

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REPORTS from the FIELD

Begins on page 152

allow rectifiers to heat up to more than 140 F. Surges of heavy voltage place more stress on the rectifier than sudden increases in amperage.

A rectifier that is about to fail from overloading may be detected by its improper performance. Resistance on the ac side increases and delivered dc voltage and current decline. Rectifiers showing such performance should be immediately removed from the circuit and discarded.

GE comments: In general, the material presented is correct. But we feel the following comments are pertinent:

The bulletin cautions against increased hazards from the use of "heavy duty" rectifiers. It should be pointed out that "heavy duty" rectifiers are associated with large pieces of equipment and the amount of heat that has to be dissipated is such that ventilation is imperative. This increased ventilation reduces the probability of contamination concentrations at levels that would be injurious.

High quality, high temperature rectifiers, such as the products of General Electric Co, operate from 150 to 170 C, which is considerably above the 140 F indicated. The report should leave the door open for operation of high grade rectifiers at the elevated temperature.

The suggestion that a rectifier be removed from service when it is "about to fail" is not practical except in the case of low quality rectifiers that age rapidly. These should be removed from service when the change in forward drop or increase in leakage indicates that failure is imminent. In the case of high quality rectifiers, it is very difficult to determine when such failure is imminent.

Special line of valves for super-critical plant

► A NEW LINE of valves rated 7250 psi at 700 F or 10,800 psi at room temperature has been developed by Edward Valves, Inc. They will be used in the super-critical power plant now being built at Philo, near Zanesville, Ohio, for the Ohio Power Co.

The valves are tested in specially designed steam superheater loops using temperatures as high as 1300 F, pressures up to 5000 psi.

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► A 17-TON MOBILE UNIT substation will help New England utility companies meet their steadily rising electric power requirements.

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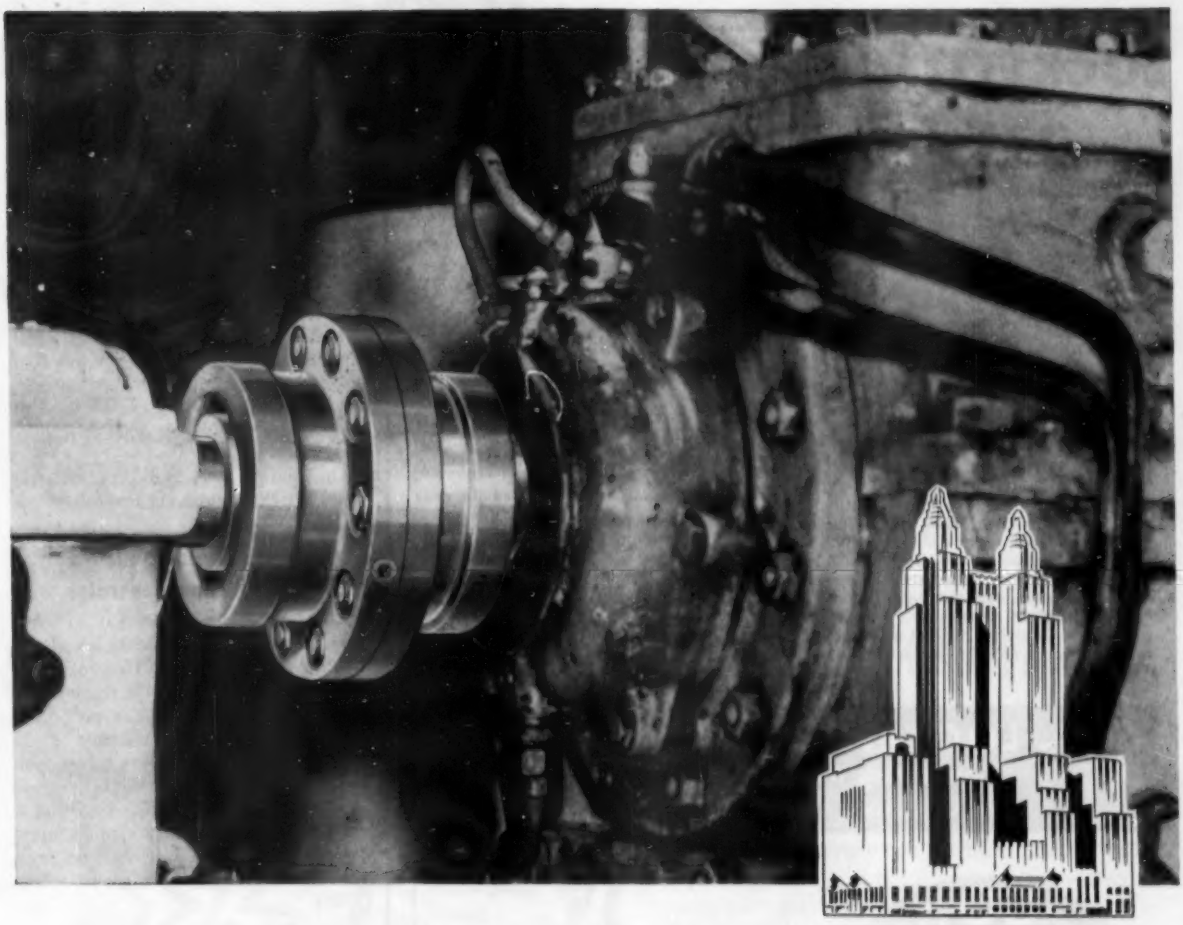

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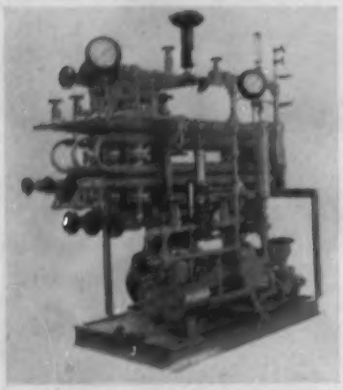

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REPORTS from the FIELD

Begins on page 152

former and switchgear equipment needed to replace any of 17 permanent substations in the New Bedford Gas and Edison Light Co System. The company plans to use it to reduce extended outages in cases of emergency and to provide increased maintenance of permanent substations.

Rated at 2500 kva, the unit is designed for connection to either a 12,650 or 22,000-volt circuit. By means of a special series-parallel delta-wye switch, the low-voltage winding can be used to connect to a 2400, 4160, 4800 or 8320Y-volt circuit.

The station was built by General Electric's Pittsfield works.

Consolidated Edison to install 300,000 kw turbine-generator

► Consolidated Edison Co of New York has ordered a 300,000 kw steam turbine generator from General Electric Co. It is scheduled for shipment to Astoria Station in 1957, as part of a $65,000,000 expansion program.

The machine will be a cross-compound reheat unit, with high pressure element operating at 3600 rpm and a double-flow low pressure element operating at 1800 rpm. Initial steam pressure will be 2000 psi at 1050 F; reheat 1000 F.

Historic scenes from Atomic Energy Commission plants in Idaho and Pittsburgh, now unclassified, will be seen publicly for the first time in a 30-minute movie purduced by the Westinghouse Electric Corp. Entitled "A Dawn's Early Light" it has been filmed in both color and black and white. For information about booking or buying this film, write Westinghouse film division, Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

Henry Vogt Machine Co, manufacturers of steam generators, heat transfer equipment, pressure vessels, valves, fittings, flanges, refrigeration and ice-making equipment, is celebrating its 75th anniversary.

Paper industry's largest steam turbine-generator will be built for International Paper Co by General Electric Co. The 40,000-kw single automatic-extraction condensing unit will be installed in the paper company's new $20,000,000 newsprint mill being built adjacent to its Southern Kraft Division mill in Mobile.

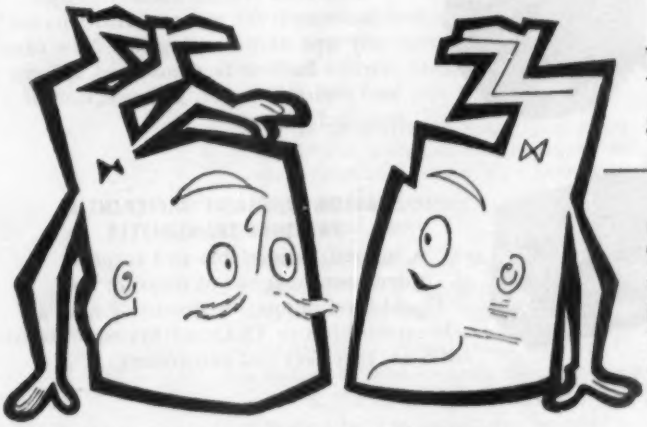
Leslie Co of Lyndhurst, N. J. is commemorating its 50th yr at its present site. The 54-yr old firm manufactures pressure, temperature and liquid-level regulators and controllers, steam and air whistles and strainers for protection of equipment installed in fluid piping systems.

Our coal bills are lower than they used to be. Are we getting cheaper coal?

No. The coal may be higher priced, but it just costs less.

Man, you've gone crazy! Telling me high-priced coal costs less.

That's exactly what I mean. This coal has less moisture and less ash. That leaves more usable coal in every ton. It burns better in our type of boiler. Add it up, and we're getting the same amount of steam with a lot less coal.



How did you find out about this coal?

I asked the Chesapeake and Ohio coal people to recommend a coal that would give less smoke. The coal they suggested not only burns practically smokelessly, but as you see for yourself, it costs less. I used to buy coal strictly on price, but I know better now. Picking the right coal for any particular set of conditions is a job for an expert.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

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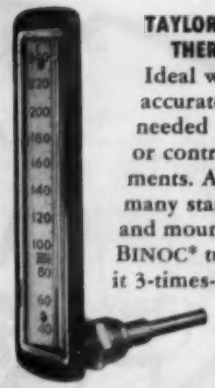

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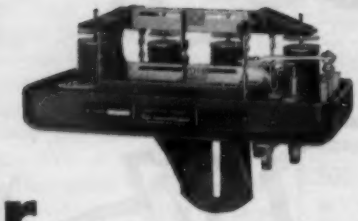

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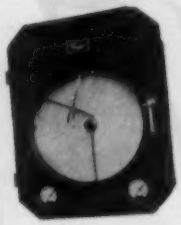

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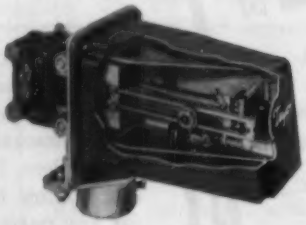

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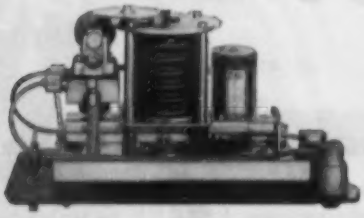

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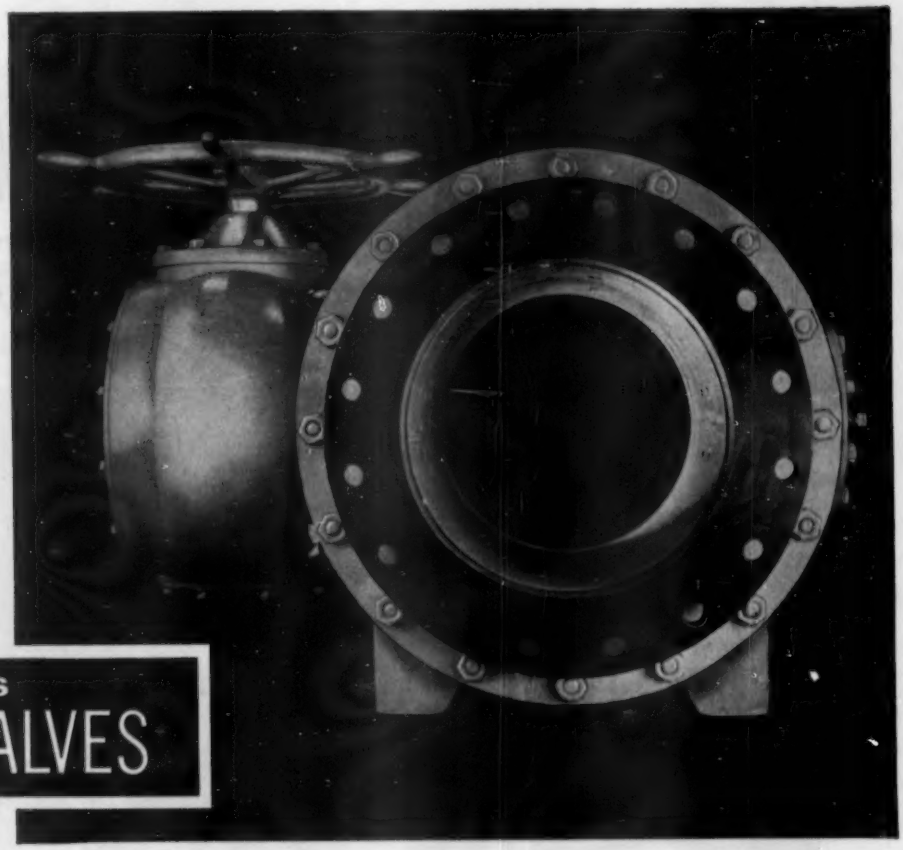

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a new achievement in valve performance . . .
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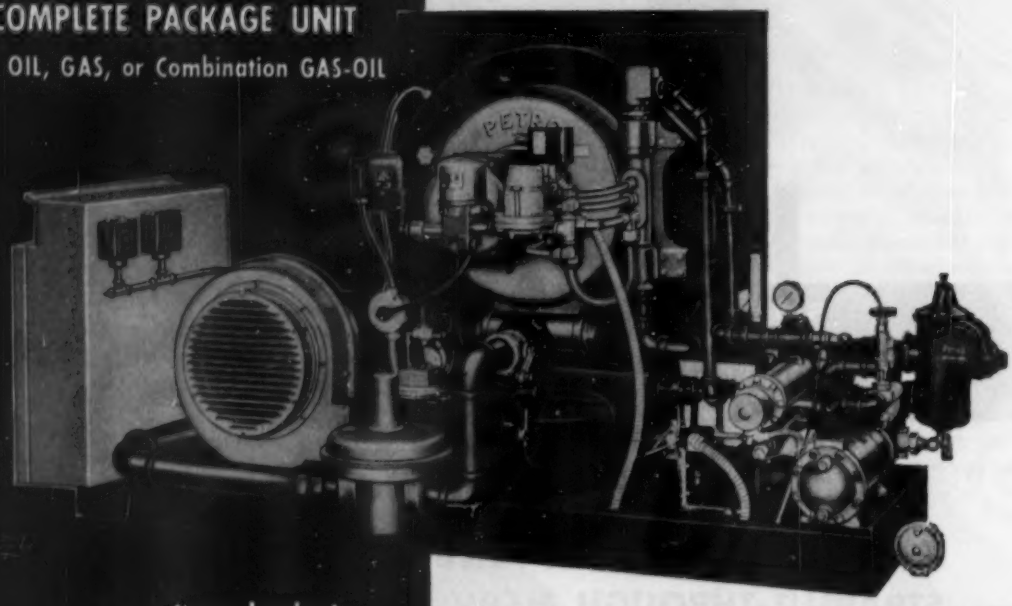

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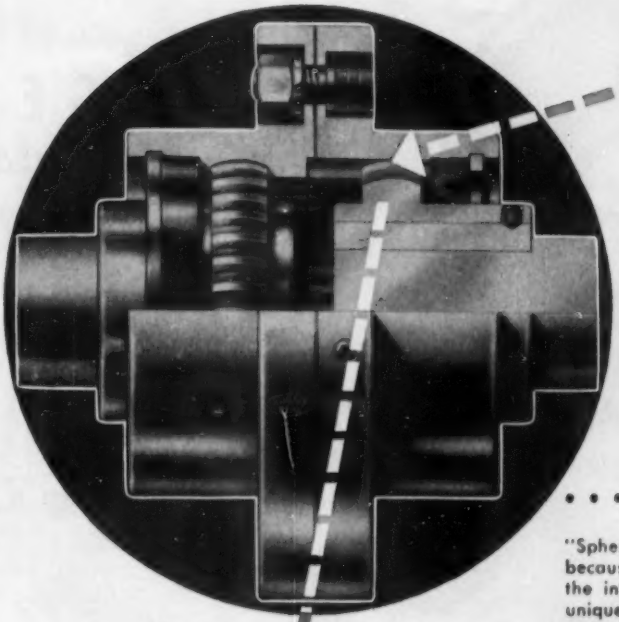

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"Sphereflex" is entirely *different* than any other coupling, because the male teeth are cut on a "true spherical arc" and the internal teeth are cut with a "straight root" . . . This unique combination permits the curved teeth to constantly maintain a *full line of contact* with the internal teeth, *even when the coupling is flexed;* in addition, this feature makes it *absolutely unnecessary* to depend upon excessive backlash between coupling teeth, point contact or springs, in order to secure true flexibility. Size for size, "Sphereflex" Couplings will withstand higher horsepowers and greater mis-alignments than any other comparable couplings.

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When you buy "Sphereflex" Couplings, you secure the background of 64 years in power transmission engineering and experience, covering thousands of jobs in every line of industry and transportation.

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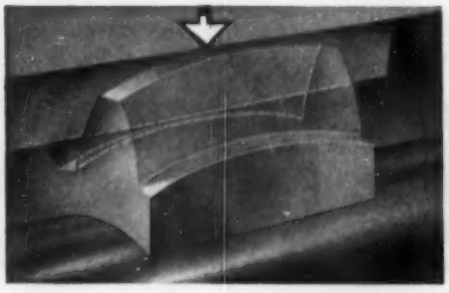
NOTE—
teeth are cut on a true spherical arc



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No tendency toward unstable, unpredictable performance!

With the Clarage Type NH Fan you get efficiency where it counts: under actual operating conditions. Modern manufacturing techniques assure that each of these fans is accurately constructed to perform according to its rating and in line with its advanced design.

As fully described in Bulletin 802, Type NH, Class II-A forced draft fans are provided with independent bearing pedestals, split type housings, and non-overloading, backwardly inclined wheels (diameters 15" to 66").

Users agree that here is thoroughly dependable equipment fully answering within its performance range the requirements of modern power plants. For heavier duty forced draft service, Clarage fans are available in Classes III and IV construction.

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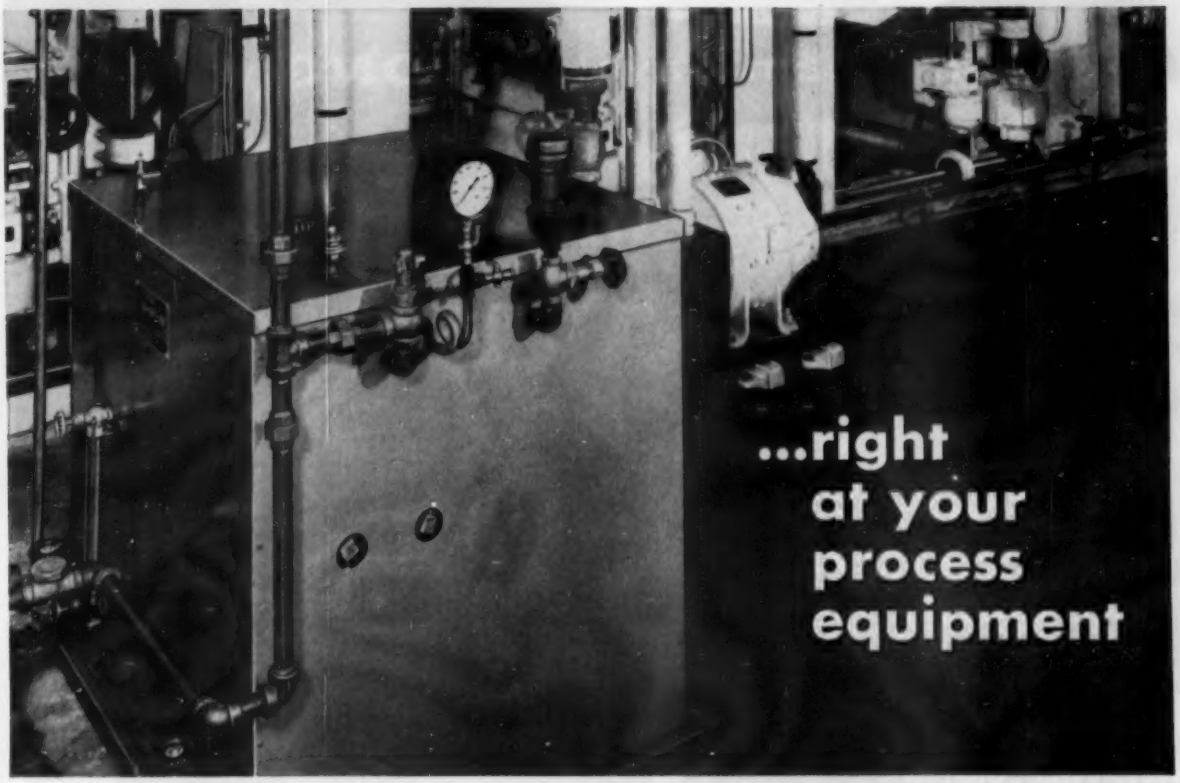
You can Rely on... **CLARAGE**

Headquarters for Air Handling and Conditioning Equipment

ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • *IN CANADA:* Canada Fans, Ltd., 4285 Richelieu St., Montreal

for as little as $685

you can have high pressure steam



with a Pantex Speedylectric Steam Generator

Think of it! — Speedylectric lets you have constant temperature "dry" steam wherever you want it for as little as $685. Install it near your platen presses, or for degreasing, and phosphatizing, or on jobs that are remote from your central boiler. No fumes, no flame, no smoke-stacks or other complicated installation problems. Just plug in to either 220, 440 or 550v outlet, connect piping, and you have an ever-ready source of high pressure steam that you can control precisely.

Speedylectric utilizes the electrode principle — the simplest, lowest cost method for generating steam electrically. It has no coils, tubes or electric elements to scale and burn out. No feed water treatment or daily blow-down is needed. Equally important, Speedylectric is safe from fire dangers . . . no open flame or low water explosion hazards. (Underwriter's Laboratories Listing) 1½ to 60 Bhp; 15 to 500 Psi. Why not write for complete data and illustrated Bulletin.

Speedylectric Steam-Jet Cleaner lets one man do the work of five. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment *without* flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

Pantex Manufacturing Corporation
Box 660Y Pawtucket, R. I.
Send me complete illustrated data on:
☐ Pantex Speedylectric Steam Generators.
☐ Pantex Speedylectric Steam-Jet Cleaners.

NAME AND TITLE _____
COMPANY _____
ADDRESS _____

In Canada: Pantex Manufacturing, Ltd. 3556 St. Lawrence Blvd., Montreal

when steam travels a **LONG** way . . .

San Francisco International Airport

Heating Contractor: Anderson & Rowe, Inc.;
Architect: W. P. Day & Harry Michelson, Assoc.
Engineer: Clyde Bentley.

KEWANEE reserve plus rated boilers

. . . guard against heat loss

In airports, where height is a hazard, buildings hug the ground. They grow OUT instead of UP. And because steam must travel great distances, there can be a marked loss of heat in long piping runs. Here space is valuable too, so areas to house boilers must be kept compact. Such was the problem at the San Francisco International Airport. Solution called for space-saving boilers large enough to supply steam to the remote corners of the sprawling airport buildings, and with sufficient reserve to compensate for transmission heat loss. Kewanee reserve plus rated boilers were selected because they offered a compact installation with enough power to guard against heat loss, yet maintain required temperatures. Kewanee Boilers assure savings in fuel and maintenance since they operate at "cruising speed" with 50% more power built-in to provide for piping, pickup and additional capacity requirements. So be safe—be sure—select Kewanee.

Two #588 125# Kewanee Firebox Boilers with combination gas & oil burners.

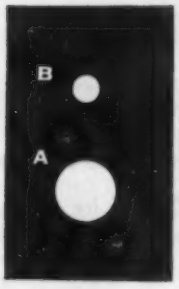
KEWANEE-ROSS CORPORATION • KEWANEE, ILLINOIS
Division of American Radiator & Standard Sanitary Corporation

KEWANEE ROSS

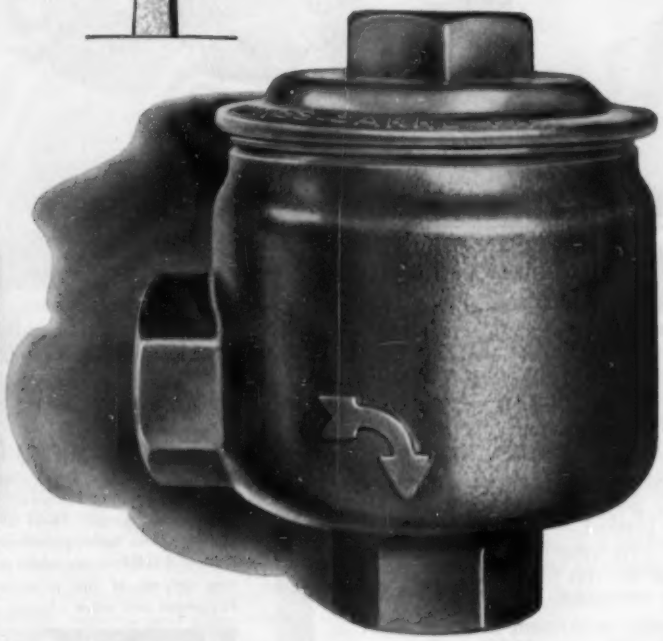
Serving home + industry American-Standard • American Blower • Church Seats & Wall Tile • Detroit Controls • Kewanee Boilers • Ross Exchangers • Sunbeam Air Conditioners

TALK ABOUT

Capacity



Discharge orifice of 1" NICHOLSON trap (A) compared with other types of same size (B). Nicholson's greater—in every size!



Compare capacity of a Nicholson Steam Trap with any other trap of same size. Greater capacity—right across the board—means Nicholson Industrial Traps discharge condensate and air from steam lines and process equipment *faster*, more *effectively*. In toughest steam distribution service, Nicholson's pay off 4 ways:

- **lower initial cost—more for the money**
- **less upkeep expense—minor maintenance**
- **faster warmup—high, even temperatures**
- **faster production—increased 20% to 30%**

Where performance counts, specify Nicholson. Write for *Catalog 953*.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 50 PRINCIPAL CITIES

Are unused "horses" eating your profits?

save money by matching the load . . . let silicones carry the overload!

Dow Corning Silicone insulated (Class H) motors give you a service factor ranging up to 50% compared with 15% for Class A.

This extra service factor enables you to install Class H motors rated at normal load requirements and yet meet initial or intermittent overloads, or loads that can't be matched in standard frame sizes.

In one of our fluid pumping applications, for example, normal load is 5 hp; intermittent loads range up to 9.2 hp. Instead of following the old fashioned practice of overmotoring with a 10 hp Class A motor, we use a 5 hp Class H motor and let silicones carry the overloads.

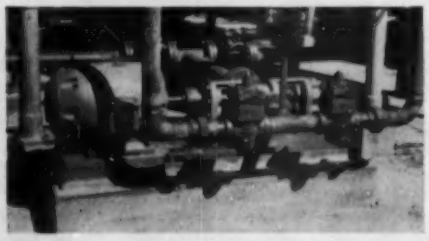
That means less capital investment in motors. It also means a better power factor and higher efficiency because smaller silicone insulated motors operate nearer full load more of the time than larger motors rated to meet maximum overloads.

And you get more reliable operation because motors insulated with Dow Corning Silicones have superior resistance to heat, and moisture and to corrosive atmospheres.

Remember, overmotoring is outmoded

to help you avoid overmotoring

Sier-Bath Gear and Pump Company, Inc. of North Bergen, N. J., now offers silicone insulated (Class H) motors as optional equipment on all of their positive displacement pumps. These Class H motors with their built-in service factor permit you to match the average load and safely carry initial or intermittent overload. You get all of the advantages of more compact equipment and more efficient operation.



Dow Corning Corporation, Dept. 6911, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

☐ Information about Sier-Bath pumps with Class H motors

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

Attention to Detail is the Reason Why...

You Get More Value When You Buy S-E-Co.

Take the nameplate pictured above . . . Actually it's more than a mere nameplate, it's a carefully designed cover for an access opening in the **new S-E-Co. Coal Valve.** A fitted, molded gasket makes it absolutely dust-tight. Step construction makes the inside face flush with the valve interior to assure good coal flow and eliminate what would otherwise be a pocket to catch water and cause corrosion. Wing nuts allow easy and quick removal and replacement.

Other small details that add up to a big difference are . . . stainless steel shells on the large ball bearing gate supporting rollers . . . deep groove in pocket sheave to insure good tracking of chain . . . heavy hand chain that comfortably fits operators hands and is hot galvanized to prevent its rusting . . . lap closure of gate on all four sides to assure positive cutoff and ease of closing through standing column of coal . . . self-cleaning racks and pinions.

The best costs little more than the average and quickly pays for itself. For a complete list of the outstanding features of the new S-E-Co. Coal Valve write for Bulletin No. 97.

STOCK Equipment Company

745-P, HANNA BLDG., CLEVELAND 15, OHIO

How to Select an Economical Temperature Regulator

First of all, what does economy mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

Packless construction . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

A guarantee against wire drawing of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

Broad control range. In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

Easy maintenance. Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

Double duty. There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

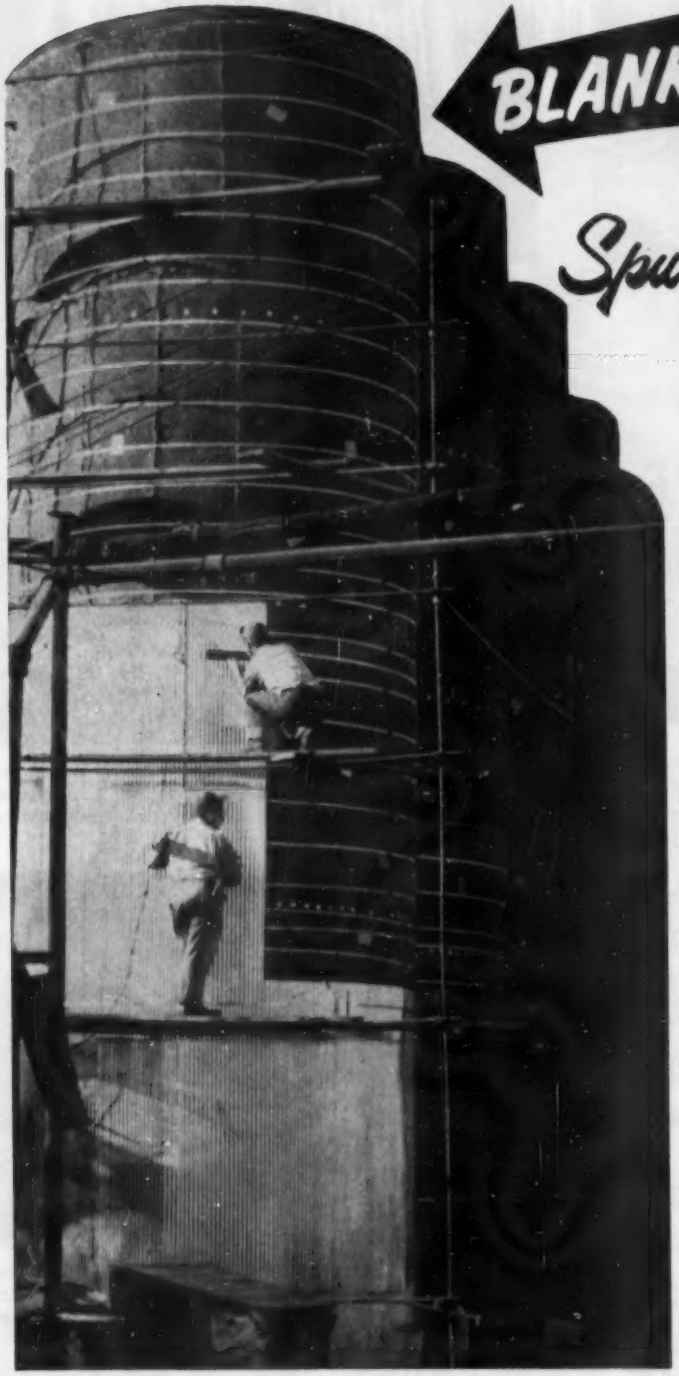
Self-operating. Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details? **SE 120**

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

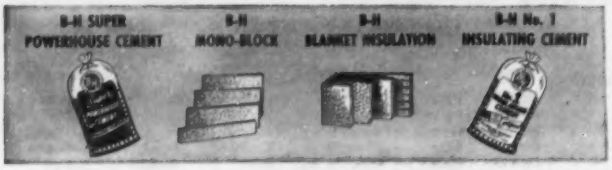
NOW... a better insulating BLANKET made with BALDWIN-HILL Spun MINERAL WOOL



Baldwin-Hill Insulating Blankets now have lower density but greater strength due to the longer, finer mineral wool fibers produced by the NEW B-H spinning process. With the lighter weight, B-H Blankets are applied with amazing ease and speed.

HOT
COLD
This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-48 as issued by U.S. DEPARTMENT of COMMERCE
CERTIFIED BY MANUFACTURER
No. 100

Storage Tanks insulated with 1½" thick B-H Blankets having 1" wire mesh on one side; expanded metal lath on other side.

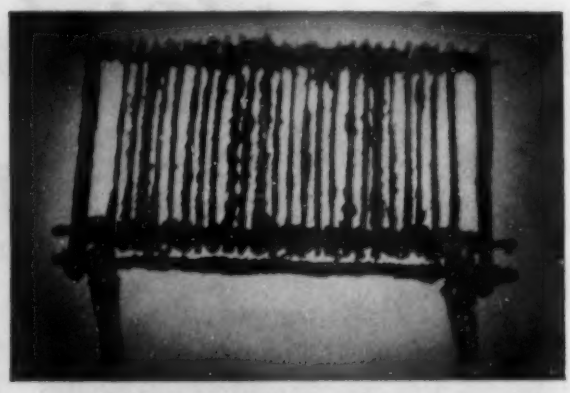


BALDWIN-HILL COMPANY

111 Breunig Ave. Trenton 2, N. J.

Kalamazoo, Mich. Huntington, Ind. Temple, Texas

LABORATORY TESTING—The modern Chase laboratories provide an excellent testing ground for condenser tubes under conditions met in many varied industries.



FIELD TESTING—This rack of test specimens was in a heat exchanger. These field tests help Chase perfect the alloy best suited for *your* job.

How to be *SURE* about CONDENSER TUBES

Take Chase Antimonial Admiralty or Cupro-Nickel Tubes, for instance. You *know* they'll give you years of service. They're manufactured under carefully controlled conditions. They're tested for every stress, strain and attack. They're inspected again and again. When a Chase condenser tube goes into service we're *sure* it will stand up. You can be sure, too.

CARE IN MANUFACTURE—During every step of the way from casting to packing, Chase tubes are carefully supervised and continually tested.

YEARS OF ACTUAL USE—Chase condenser tubes and heat exchanger tubes save industry thousands of dollars annually . . . because they last longer.

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper (†sales office only)

Albany†	Chicago	Detroit	Los Angeles	New Orleans	Rochester†
Atlanta	Cincinnati	Grand Rapids†	Louisville†	New York	St. Louis
Baltimore	Cleveland	Houston	Milwaukee	Philadelphia	San Francisco
Boston	Dallas	Indianapolis	Minneapolis	Pittsburgh	Seattle
Charlotte†	Denver	Kansas City, Mo.	Newark	Providence	Waterbury

Now—CORROSION PROTECTION at a BUDGET PRICE

● Here is a deaerator of Schaub quality, engineered on new principles, designed especially to put effective boiler feed water deaeration within price reach of the small to medium size plant.

These plants, from 3,000 to 30,000 lbs/hr., often running at low pressure, are likely to have the same corrosion and high maintenance costs as their "big brothers". In fact, "Return Line Corrosion" is *most apt* to occur in *low pressure* heating systems even though raw water make up is negligible. For such plants, as well as for high pressure installations, the Schaub .03 Deaerator offers an effective and economical solution that will pay for itself many times over.

The Schaub .03 Deaerator operates *fully vented* at atmospheric pressure. Premium cost construction is eliminated, maintenance and operating costs are reduced to a minimum. Liberated, non-condensible gases escape *immediately* and *completely*. At the same time, simple but effective spray-contact vent condensing, prevents wasteful steam vapor loss. Pin-point temperature control, "live-action" heating and rust-proof chromasoid lining are exclusive features.

FRED H. SCHAUB ENGINEERING COMPANY

2105 South Marshall Boulevard • Chicago 23, Illinois

Get the Full Story on This More Efficient Low Cost Deaerator — Write for Bulletin 1300

Simple though it is, there's much more to the Schaub .03 Deaerator than can be told here. Bulletin 1300 is filled with information for the operating or consulting engineer responsible for economical and efficient deaeration of boiler feedwater. Tells the "hows" and "whys" of deaeration, especially for the small to medium size plant, explains how the Schaub method differs and its advantages in performance and low cost. Mail the coupon today.

NOTE: The Schaub .03 Deaerator is designed for boilers up to 30,000 lbs. per hour. For capacities up to 100,000 lbs. per hour at .005 cc/liter "zero-oxygen" removal write for Bulletin 575, describing the Schaub Zero-Oxygen Deaerator.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

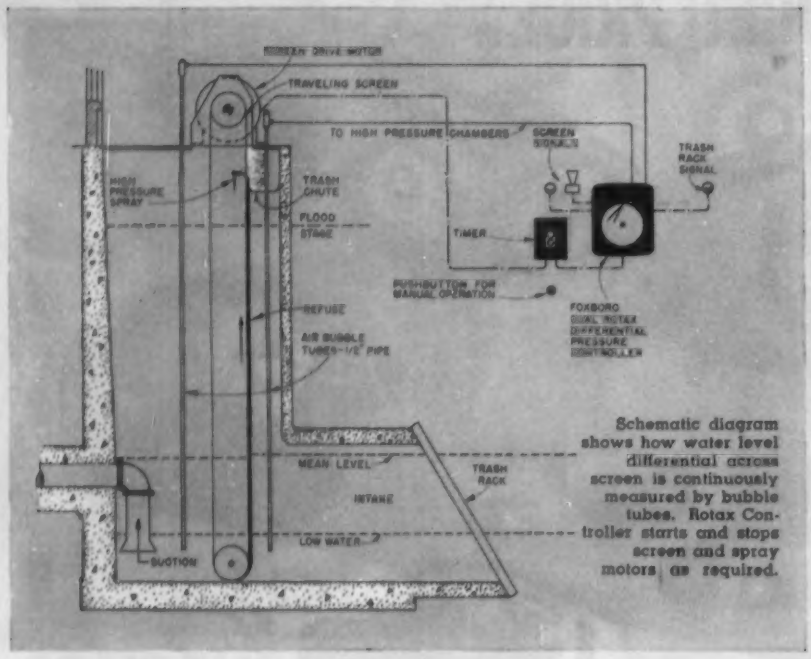
NAME.....

COMPANY.....

ADDRESS.....

CITY.....ZONE....STATE.....

Make traveling intake screens positively "Plug-Proof"



Schematic diagram shows how water level differential across screen is continuously measured by bubble tubes. Rotax Controller starts and stops screen and spray motors as required.

. . . with Foxboro liquid level type screen control

Make sure your intake suction well can't go dry when excessive refuse suddenly piles up on the traveling intake screen!

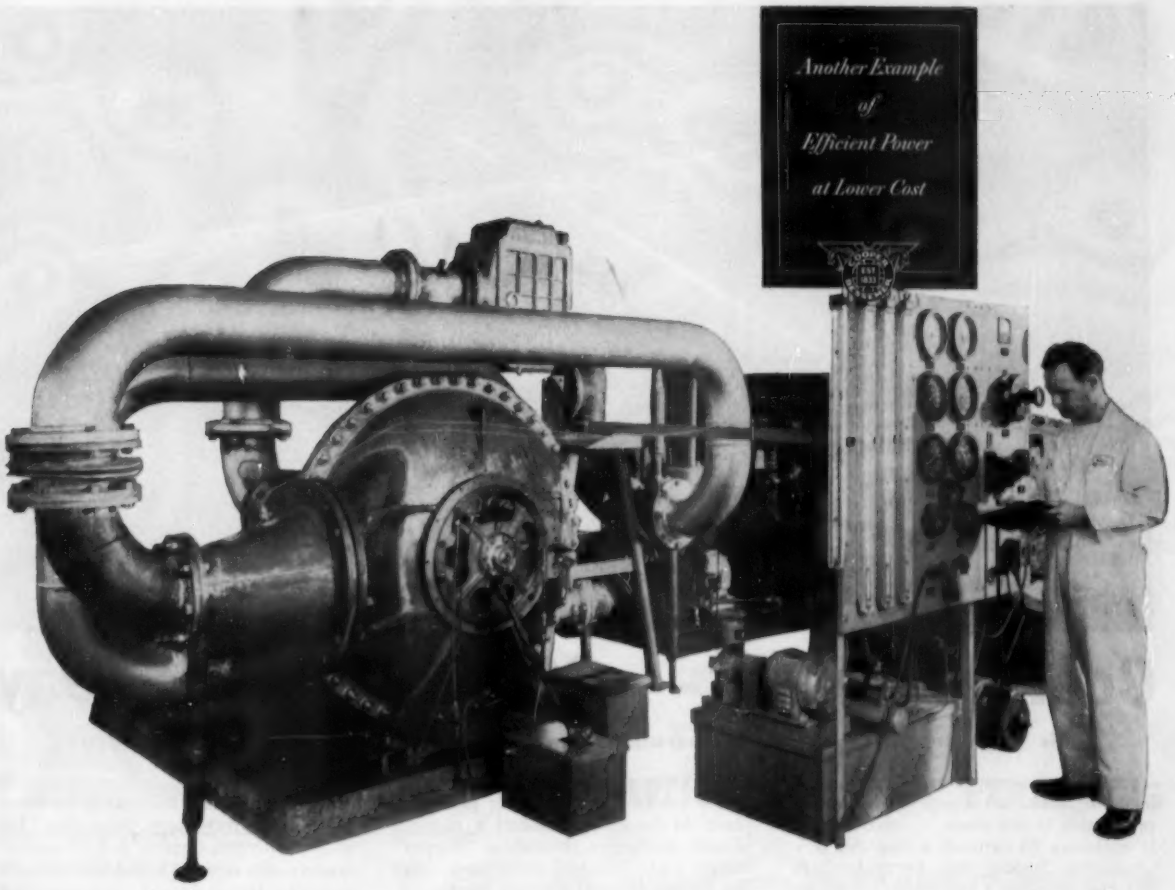
The Foxboro Traveling Screen Control System automatically starts the screen-rotating motor and the cleansing spray whenever refuse accumulation causes the water level difference between opposite sides of the screen to exceed a certain preset value. Quickly, it purges the screen of refuse and restores the intake level to normal — or sounds an alarm indicating that the cleaning mechanism is unable to cope with the difficulty. What's more, this action takes place only when the screen actually becomes clogged . . . no waste of power or unnecessary wear on mechanism through needless periodic operation.

The Foxboro Traveling Screen Control System is easy to install, inexpensive to operate, and pays big dividends in better intake operation, less maintenance and greater peace of mind. Write for complete information. **The Foxboro Company, 6811 Neponset Ave., Foxboro, Mass., U.S.A.**

ROTAX Liquid Level Controller. The heart of the system, translates level differential into operation of motors. In addition, it can operate warning horn or light in case of unusually severe fouling. Circular or rectangular case models.

FOXBORO
REG. U. S. PAT. OFF.
INSTRUMENTATION
INDICATING · RECORDING · CONTROLLING

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND



Hot compressor... prescribed for new problems

PRAISE be, American industry is always on the go—always working out new and better ways to do things. A good example is today's incredible chemical and petrochemical industry. As in most other industries, new processing techniques have posed new problems. One is how best to handle the huge-volume compressing of gases and air. And that is a field in which Cooper-Bessemer has a 100-year stake.

Shown above during test stages is one of Cooper-Bessemer's latest answers—a highly efficient, remarkably compact, multi-stage *centrifugal* compressor, that can be driven by electric motor, internal combustion engine or turbine. These space-saving compressors will help solve many new problems of industry; are already in phases of government service.

Although such centrifugal compressors are new in application, they are not new in Cooper-Bessemer experience. Here work on rotating compressor equipment has been under way for years . . . anticipating these very problems . . . and the answers.

It's easy to determine whether your compressor needs can be met best, most economically with reciprocating units . . . or with new-type centrifugals. It's also easy to find out all about the *new* things being done by one of America's *oldest* engine and compressor builders . . . and it pays!

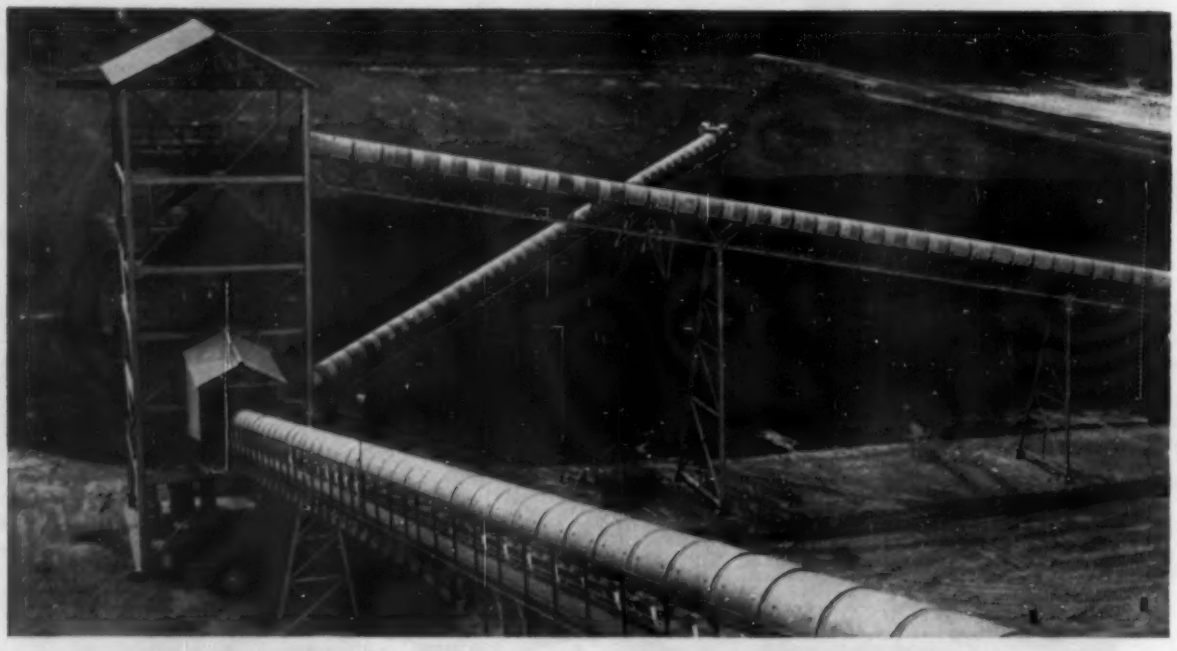
Mount Vernon, Ohio

COOPER-BESSEMER

Grove City, Pa.

New York • Chicago • Washington • San Francisco • Los Angeles • San Diego • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Gloucester • New Orleans • Shreveport
Cooper-Bessemer of Canada Ltd., Halifax, N. S., Edmonton, Alberta

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS • HIGH PRESSURE LIQUID PUMPS



Coal Conveying - - - 26 Carloads Per Day

Louis V. Sutton Steam Electric Generating Plant • Carolina Power and Light Company

Temporary interruption of the flow of incoming coal can't interfere with power production at this plant . . . even though it consumes 26 carloads a day. An S-A Conveying System that keeps bunkers full and develops a million-dollar stockpile makes sure of that.

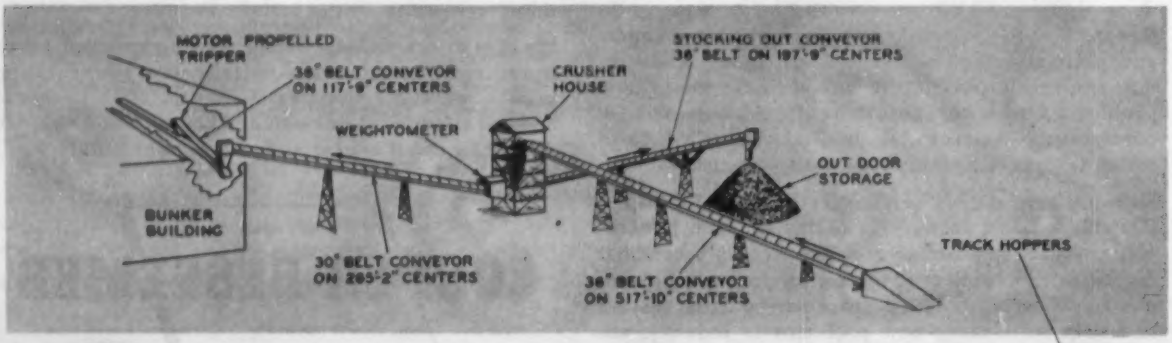
Coal arriving by rail cars is dumped into the track hopper. An S-A slope belt conveyor takes it, 450 TPH, to the "open air" crusher house. The coal is reduced to minus ¾" size in an S-A Knittel crusher that can't clog and that delivers *full capacity* even when handling wet, sodden coal.

From the crusher house, coal goes either to the stocking out conveyor or to the plant. At the storage bunkers a traveling tripper discharges through a "Zipper" bunker seal. This seal opens and closes like a slide fastener through bunker openings directly under tripper spouts, so that no dust can escape.

Coal to be stockpiled travels by a stocking out conveyor and is discharged through a telescoping spout that automatically shuts off flow when the pile reaches a predetermined height. Coal to be reclaimed is returned to track hopper by bulldozer or carry-all.

Corrugated steel hoods over all outside conveyors, and dust curtains at discharge points, effectively keep down dust. For all belts rugged, durable S-A "Simplex" carriers with spun ends and bearings protected by labyrinth seals were specified.

This is an example of the way S-A engineering can meet specific requirements for distribution, volume and clean handling. No matter how specialized your need, you'll find S-A experience and *complete equipment* offer a sound economical solution. Write us whenever we can help you.



STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

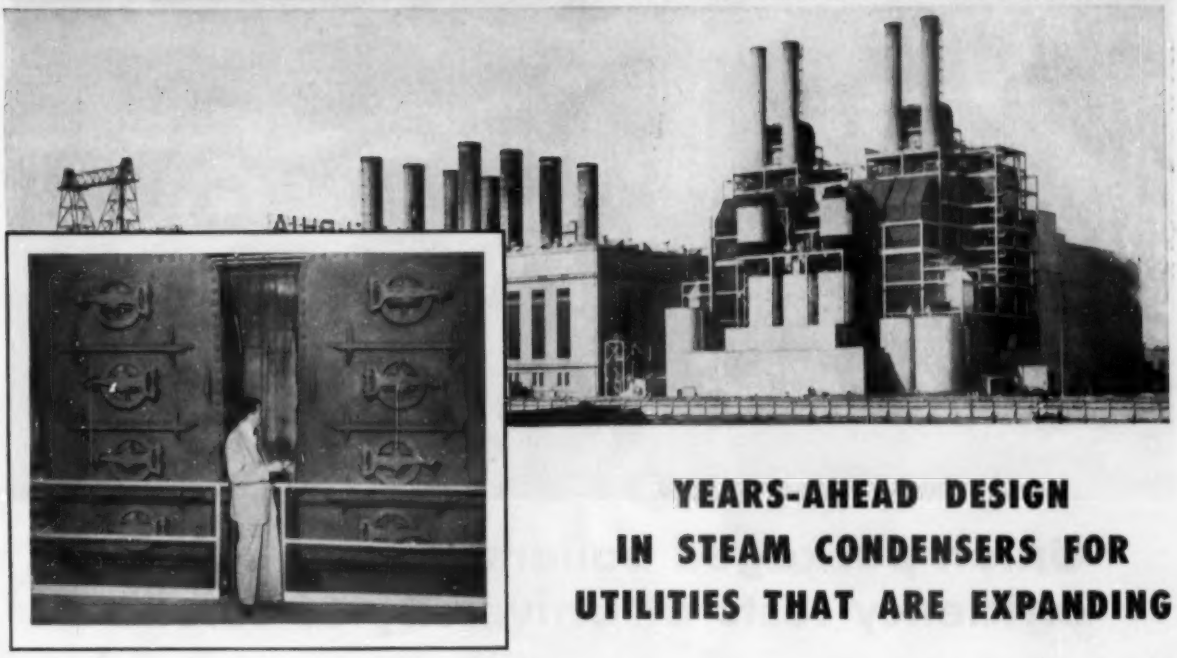
Engineering Division
Specialists in the design and development of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.

IDEAS FOR ENGINEERS

FROM C.H. Wheeler OF PHILADELPHIA



YEARS-AHEAD DESIGN IN STEAM CONDENSERS FOR UTILITIES THAT ARE EXPANDING

The Philadelphia Electric Company, for example, is one of the fastest growing utilities in the U. S. Here, men are thinking and working years ahead to take care of the "exploding" growth of the industrial Delaware Valley, and the ever-increasing population of Philadelphia, the "City of Homes". Nothing short of the most advanced design and efficiency of new equipment can be considered by the Philadelphia Electric Company to keep its generating capacity safely ahead of loading.

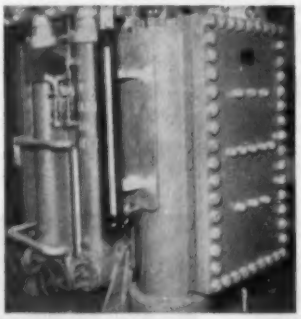
As part of their expansion program, two C. H. Wheeler 60,000 sq. ft. steam condensers are installed at the new Delaware Station. These are surface condensers of modern design; dual bank, single pass, divided water box type. Each unit condenses steam for a 125,000-kilowatt turbo-generator. Photo shows close-up of water box and manhole detail.

MAIN AIR EJECTORS ..by C. H. WHEELER

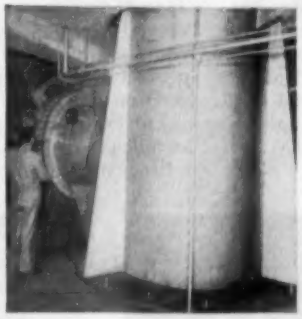
An important factor in the performance of the C. H. Wheeler Steam Condensers is the efficiency of the main air ejectors. C. H. Wheeler has always been the source for the latest developments in steam jet air ejectors.

The streamlined, steel-shell Tubejet Ejectors installed at the Delaware Station are effecting considerable savings in space and providing dependable removal of air.

WE-505



HUGE C. H. WHEELER PUMPS DELIVER 86,500 GPM RIVER WATER



Other modern C. H. Wheeler installations at the new Delaware Station are the circulator pumps. C. H. Wheeler has closely integrated circulator pump design with modern steam generating demands. Pictured here is one of two vertical mixed flow circulating water pumps feeding Delaware River water to the new C. H. Wheeler Steam Condenser. Capacity of each pump is 86,500 GPM.

Bulletins mailed on request.

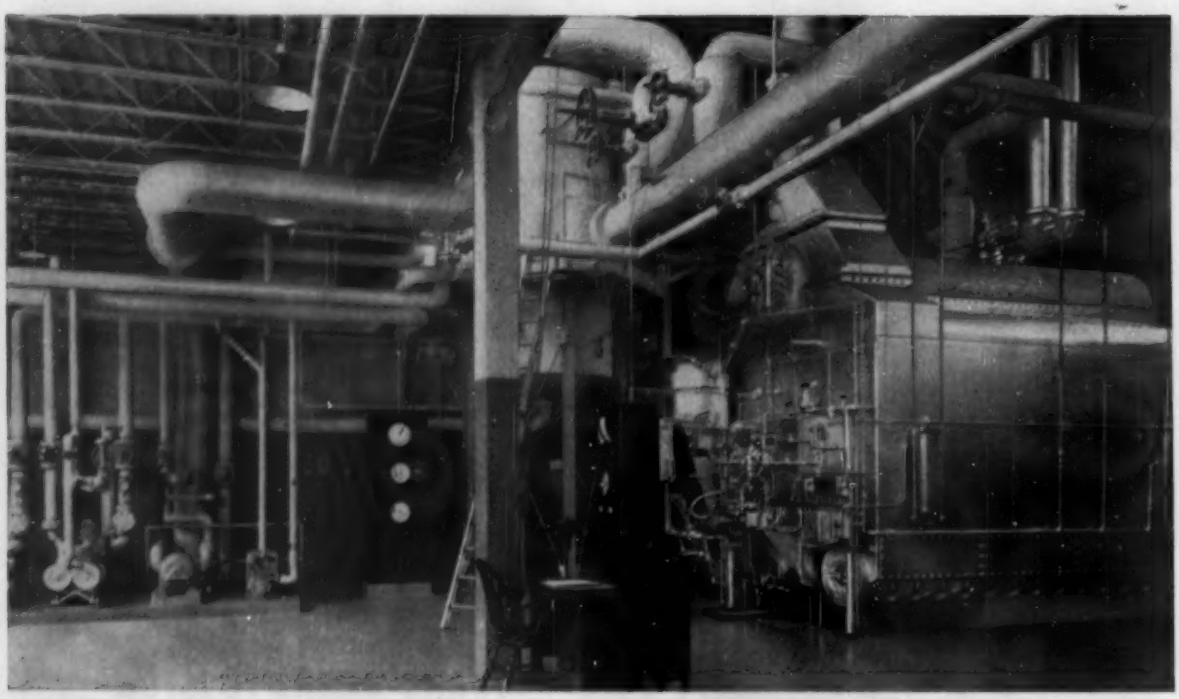
Inquiries receive prompt attention.

Representatives in principal cities.

C.H. Wheeler OF PHILADELPHIA

C. H. WHEELER MANUFACTURING CO., 19TH & LEHIGH, PHILA. 32, PENNA.

STEAM CONDENSERS · CENTRIFUGAL, AXIAL AND MIXED FLOW PUMPS · STEAM JET EJECTORS · VACUUM REFRIGERATION · HIGH VACUUM PROCESS EQUIPMENT
MARINE CONDENSERS AND EJECTORS · MARINE PUMPS · DECK MACHINERY



Union packaged boilers exceed 80% in efficiency tests at University of Toledo

Job Report (UIW)—Not only do two Union Type MH Packaged Steam Generators provide space heat for 14 buildings on the University of Toledo's 170-acre campus, but they also take part in the educational process. Utilized for laboratory work by mechanical engineering students, these Union Steam Generators are reported to operate at "better than 80% efficiency."

Says University of Toledo, "We get 128 lbs. of steam per gallon of fuel oil as compared to 93 lbs. per gallon with the old boilers formerly used. The new plant, in operation since the fall of 1953, uses #6 oil in the winter and #5 in spring and fall. During the past year, 361,746 gallons were used, producing 46,180,000 lbs. of steam."

Users who have kept tabs on Union Packaged Boilers as carefully as University of Toledo, report like economies. From coast to coast, Union Type MH Steam Generators have proved their worth in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals, to name a few.

Completely shop-assembled in Erie, Pa. for delivery via rail or truck, Union Type MH Units are patterned after larger but similar field-erected Type H Boilers, originated by Union over 16 years ago. They can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering.

For example: Superheaters can be installed to meet total temperature requirements, while air heaters and economizers are readily supplied when needed.

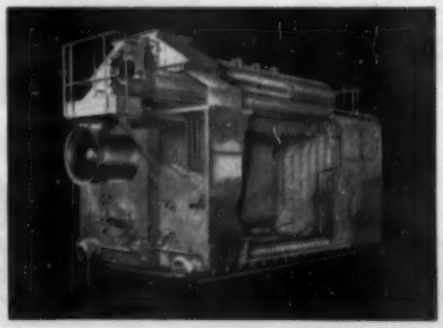
Standard units are designed in 13 sizes from 10,000 to 40,000 lbs. of steam per hour at 250 psi, with higher pressures available for special applications.

The complete story on Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.

AT TOP: 28,000 lbs. of steam per hour—that's the capacity of this Union Type MH Packaged Steam Generator which operates at 125 psig with 180 degrees feed water temperature (one of a pair serving University of Toledo).

LEFT: Steam generating plant houses two Union Packaged Steam Generators to provide space heat for 6,000 students.

RIGHT: Cut-away view of Union Packaged Boiler reveals its symmetrical, 3-drum design; divided tube banks and tangent tube wall construction.



Where a Job Well Done JOINS HANDS

The veteran RIC-WIL field supervisor and contractor join hands in a JOB WELL DONE. Expert field service is available on all RIC-WIL installations.

There is satisfaction in achievement . . . the knowledge that *BOTH* the supplier and the buyer have given their best . . . and the best in Prefabricated Insulated Piping for underground and overhead systems is RIC-WIL. The next time you specify . . . specify Quality . . . specify RIC-WIL.

Write or phone your nearest representative or send for the illustrated RIC-WIL catalog.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED

PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

THE SUN ALWAYS SHINES ON PEROLIN CUSTOMERS

USED THE WORLD OVER

on land and sea

50 YEARS OF PROGRESS have built a world-wide PEROLIN organization. PEROLIN PRODUCTS meet the maintenance needs of power plants on land and sea and they are the choice of engineers the world over. Whatever your problem, wherever you are, just call a PEROLIN representative and let him help you.

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Write today for free technical information on any of these guaranteed PEROLIN PRODUCTS:

Algae Preventive
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Brine Treatment
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The PEROLIN COMPANY, Inc.
Manufacturing Chemists since 1904
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81 WAREHOUSES IN THE U. S., CANADA, AND FOREIGN COUNTRIES

A HALF-CENTURY OF EXPERIENCE THE WORLD OVER

Now the finest of needle valves is available

416 Stainless throughout...

In the Marsh Needle Valve, operating men found a valve that was better all the way through. Then came the call for a valve of like quality and precision for corrosion service . . . to be 416 stainless steel throughout.

The valve illustrated here is the answer. Like the parent valve, this new valve has safety and strength to spare . . . guaranteed for working pressures up to 10,000 psi . . . equally efficient and effective in any lower pressure range.

It too is machined from solid bar stock—in this case, 416 stainless steel. Its precision-ground and-machined stem is hardened 416 stainless. Packing is the special "Marpak" ring . . . one-piece, non-binding, long-lasting. So finely built is this needle throttling and cut-off valve that it can be easily throttled down to exceptionally fine regulation even on extreme pressure.

Read the list of features opposite. Then write for new bulletin No. NV-2 containing complete details.

The new all stainless valves (Series 1924) includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾", 1"; also globe and angle valves with male inlet and female outlet in sizes ¼" and ½".

MARSH INSTRUMENT CO. Dept. P, Skokie, Ill.
Sales affiliate of Jas. P. Marsh Corp.

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta, Canada
HOUSTON BRANCH PLANT: 1121 Rothwell Street, Sect. 13, Houston, Texas

416 Stainless Steel ...all the way through!

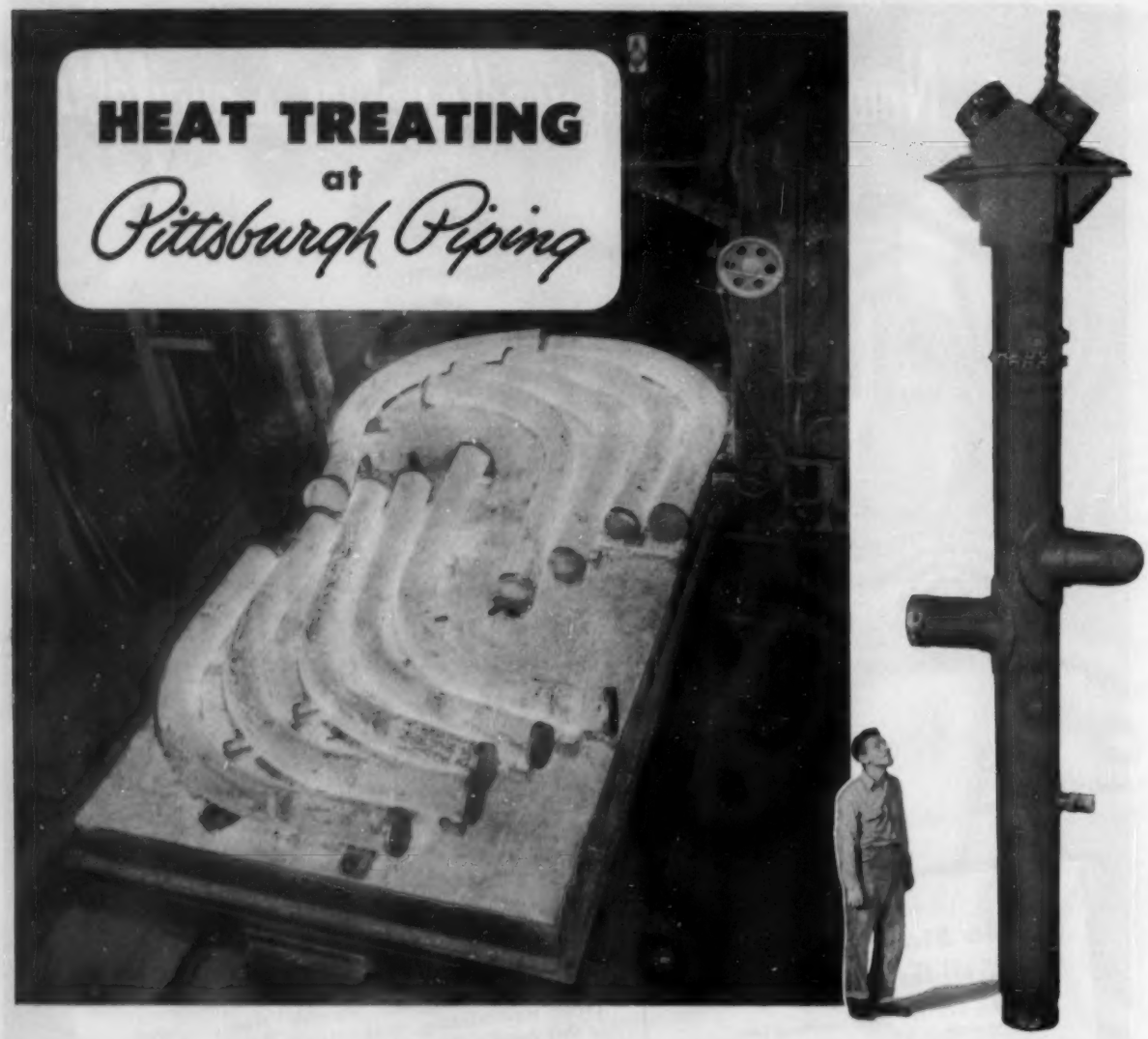
- Body and stem guide machined from bar stock.
- Valve stem, hardened stainless.
- Packing, special Marsh "Marpak" moulded ring.
- Fine stem threads for strength and precision throttling.
- Deep inlet and outlet thread chambers.
- Bodies marked in accordance with MSS regulations.

Maximum Working Pressure 10,000 P.S.I.

Water, oil, gas or corrosive fluids not injurious to 416 stainless steel.

MARSH

"THE STANDARD OF ACCURACY"



ASSURES PROPER TOUGHNESS, DUCTILITY, AND STRENGTH IN PIPING FOR HIGH TEMPERATURE, HIGH PRESSURE SERVICE

Heat treating and stress relieving at Pittsburgh Piping are operations which produce a uniform grain structure, assure consistent mechanical properties, and remove residual stresses throughout the length of each fabricated piping assembly.

P.P.&E.'s modern gas-fired furnace, illustrated above, is a specially-developed design. Time-temperature conditions can be electronically controlled in it for proper heat treatment of each type of metal.

This heat treating procedure is assurance that piping fabricated by P.P.&E. will have the most desirable combination of ductility, toughness, impact resistance, and strength.

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Crossed Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
825 BEACH ROAD—HAMILTON, ONTARIO

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Boston	10 High Street
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New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street
Washington	Wire Building

PP-13

How MOGUL solved water treatment problems for *Fruehauf Trailer* COMPANY

FRUEHAUF
FORT WAYNE DIVISION • 2601 EAST PONTIAC STREET • FORT WAYNE 1, INDIANA

June 3, 1955

North American Mogul Products Company
Standard Building
Cleveland, Ohio

Gentlemen:

We are very proud of our boiler room, which we maintain in a spotless condition, although we use coal for firing our boilers. We operate two Bigelow high-pressure boilers at or above their rated capacity of 500 H.P., 24 hours a day, for heating and processing purposes.

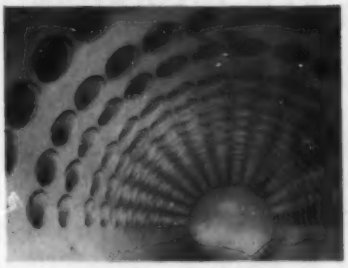
Thanks to MOGUL, our boiler drums and tubes are also spotless, even though operating under heavy load. Since September, 1953, we have used MOGUL to control our boiler water alkalinity, reduce concentration, prevent pitting, rusting and corrosion, remove existing scale and prevent further scale formation in our boilers - and at a very low cost.

The enclosed photographs are proof of MOGUL "perfection" in maintaining our boilers at peak operating efficiency.

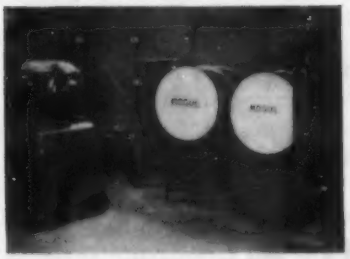
We have just changed our entire water supply from city water to hard well water. Our average daily water usage is 250,000 gallons. We are treating this water with MOGUL also, and are quite confident we will obtain the same excellent results that we do with MOGUL in our boilers.

Sincerely yours,
THE FRUEHAUF TRAILER COMPANY
Albert I. Shock
Albert I. Shock
Master Mechanic

Front of Boilers



Top of Steam Drum



Mogul on the Job

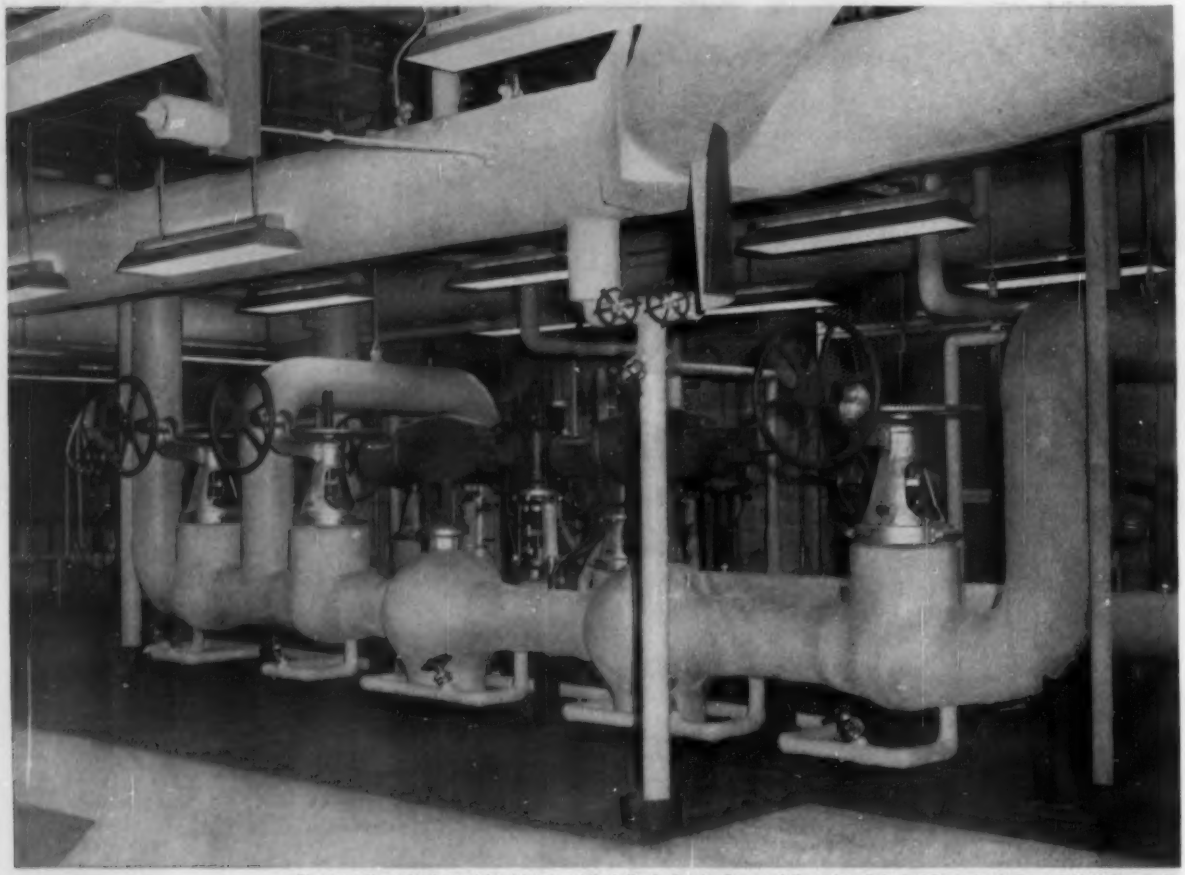
With MOGUL, you too can remove scale, rust and corrosion, effectively and economically. Write today . . . tell us of your scale problems.

MOGUL

KWIK-KLEEN
RUST ERADICATOR
EVER CLEAN BOILER PROCESS
ANTI-FOAM
ALGICIDE

The North American MOGUL Products Company
Standard [illegible] • Cleveland 13, Ohio

40 YEARS OF PROGRESS . . . AND STILL GROWING



Shown are the main steam piping (above) and the boiler-feed-water flow-regulating valves (below) at Pennsylvania Power & Light Company's Martins Creek Steam Electric Station, Martins Creek, Pa.—another installation of K&M Insulations, saving heat . . . saving fuel . . . saving money.

Is your present insulation still efficient?

HIGHER TEMPERATURES CALL FOR HEAT-SAVING K&M INSULATIONS

If operating temperatures have been increased in your plant, insulations that formerly were adequate may now be costing you many dollars in heat losses every day. As fuel costs rise, heat losses become an ever-increasing expense. For important savings in fuel, heat, and dollars, install K&M high pressure insulations—acclaimed for years for efficient heat conservation.

K&M "Featherweight"® 85% Magnesia and K&M Hy-Temp Insulations last the life of the equipment they serve. They withstand moisture, vibration, frequent temperature changes. "Featherweight" efficiently insulates piping and equipment at temperatures to 600° F. For efficiency to 1900° F., Hy-Temp and "Featherweight" are applied in combination, with staggered joints. This eliminates the heat loss that normally occurs in single-layer installations when expansion causes joints to open.

Where moisture is a problem, K&M "Featherweight" Water-Resistant Magnesia Insulation is especially effective. It is used where temperatures rise to 450° F.

Check your operating temperatures, then contact your K&M distributor—an experienced applicator—for details about the heat-saving K&M insulations your plant should have. Or write directly to us.

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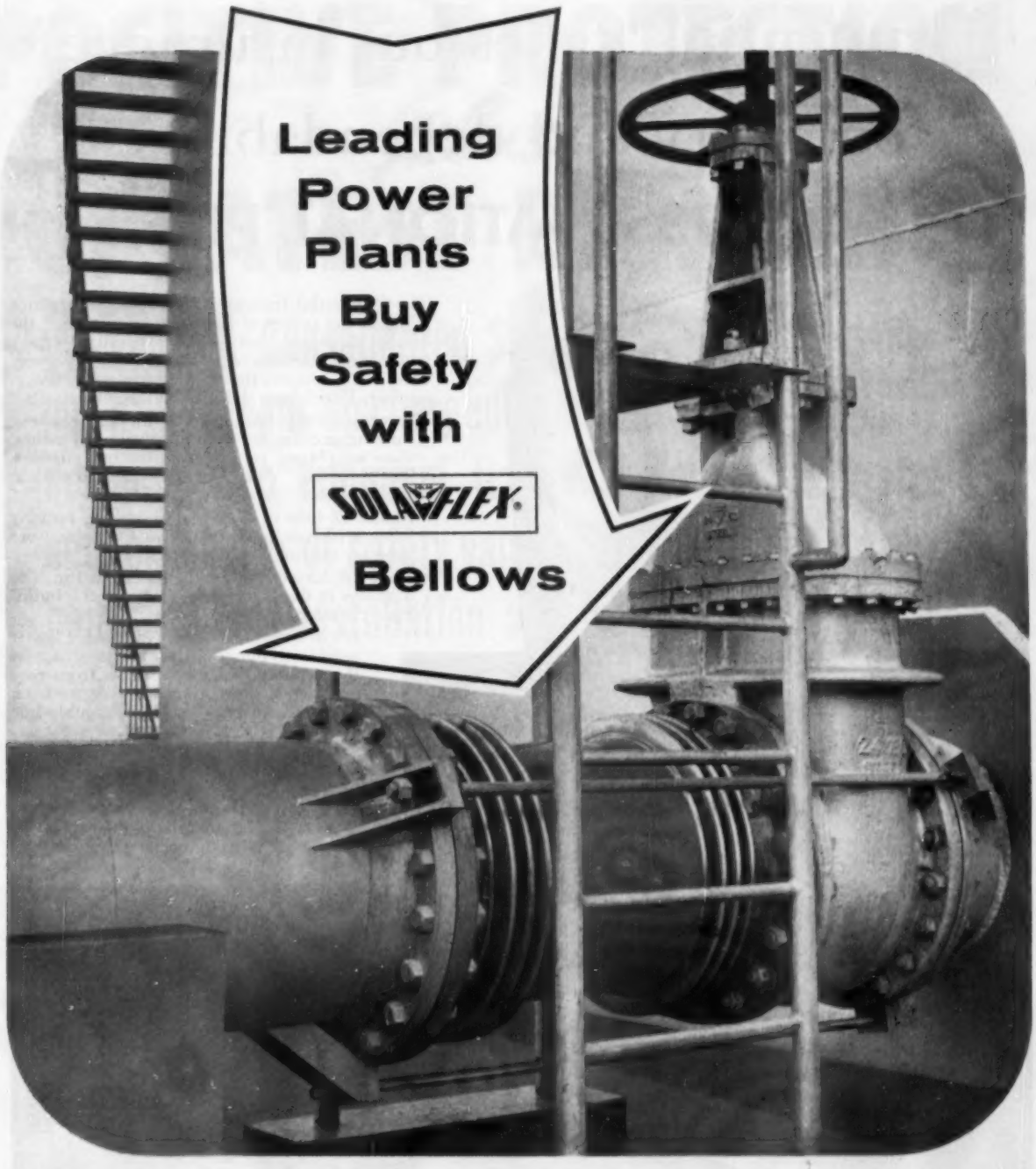
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos®

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg and Vancouver



SOLA-FLEX EXPANSION JOINTS handle the movement of this big tank and pipeline at one of the Southwest's newest and finest power plants. The 24-inch joint takes axial and lateral offset movement due to changes in pressure, or temperature or to tank shifting. Valve operation is improved, and pipe and tank installations are protected from stresses absorbed by the joint.

Sola-Flex stainless steel bellows with built-in stress rings need no external harness or "strait jacket." The Sola-Flex line meets every piping problem—convoluted for vacuum or low pressure, U-span for medium and high pressure service—in standard pipe sizes and in rectangular shapes also. Send for Sola-Flex catalogs. Address Solar Aircraft Co., Dept. B-81, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
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SAN DIEGO DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS - GAS TURBINES - BELLOWS - CONTROLS - HIGH TEMPERATURE COATINGS - AIRCRAFT COMPONENTS

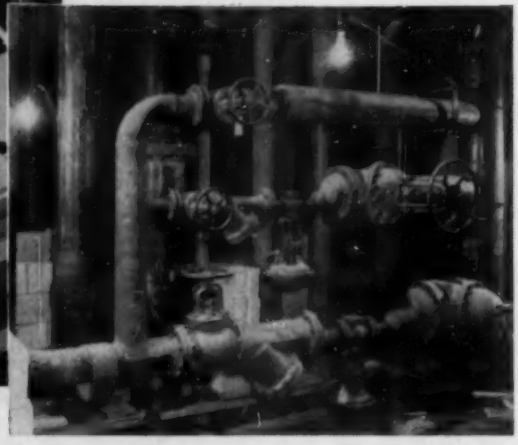
Prudential "takes out insurance" on safety and dependability with USS NATIONAL PIPE

The Prudential Insurance Company of America adopted the policy of installing nothing but the best in their new Chicago office building. That's why almost 200 tons of National Steel Pipe were used in the construction of the ultra-modern skyscraper. Here's how the material was used:

- Approximately 120 tons of National Seamless, ranging in diameter from 6 inches to 20 inches, were employed as air conditioning carriers. These "risers" run from the sub-basement to the top floors.
- About 42 tons of National Seamless, ranging from 2 inches to 14 inches in diameter were used for heating and fan rooms.
- About 20 tons of National Pipe, from 1 inch to 3 inches in diameter, help make up the building's plumbing system.

It's no surprise that National Pipe is used in so many of the "big jobs" across the country. Engineers know from past experience that they can depend on National for safe, efficient, trouble-free service.

Write us for further information on the use of National Pipe in air conditioning, heating, and power installations. And, if you'd like some personal assistance with your pipe problems, get in touch with our engineers.



Prudential Building, Chicago, Illinois
ARCHITECT AND ENGINEER: Naess and Murphy, Chicago
GENERAL CONTRACTOR: George A. Fuller Co., Chicago

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL STEEL PIPE

USS

UNITED STATES STEEL

POSITIVE PROTECTION *plus* GREATEST ECONOMY

NEW Consolidated Safety Valve cuts cost per pound of steam discharged...has maximum capacity designed into minimum flange size...reduces size and/or number of safety valve nozzles required on any boiler...saves installation and maintenance expense.

TYPE 1511
CAST IRON BODY
SAFETY VALVE

ACCEPTED by top industry as a proved Consolidated design.

Type 1511 is a new all-purpose Consolidated Safety Valve expressly designed for steam generator service. It's a space-saver . . . requires less headroom and smaller discharge piping. The spring is exposed to provide stable operation and uniform blowdown control. Greater tightness is assured because of the precision lapped flat seats. Integral, double-guided combination adjusting ring and disc guide contribute to better alignment, easy blowdown adjustment and finer performance. Full range of sizes and orifices available. Get the whole operational and economy story. Bulletin 730 has complete details. Write for a copy.

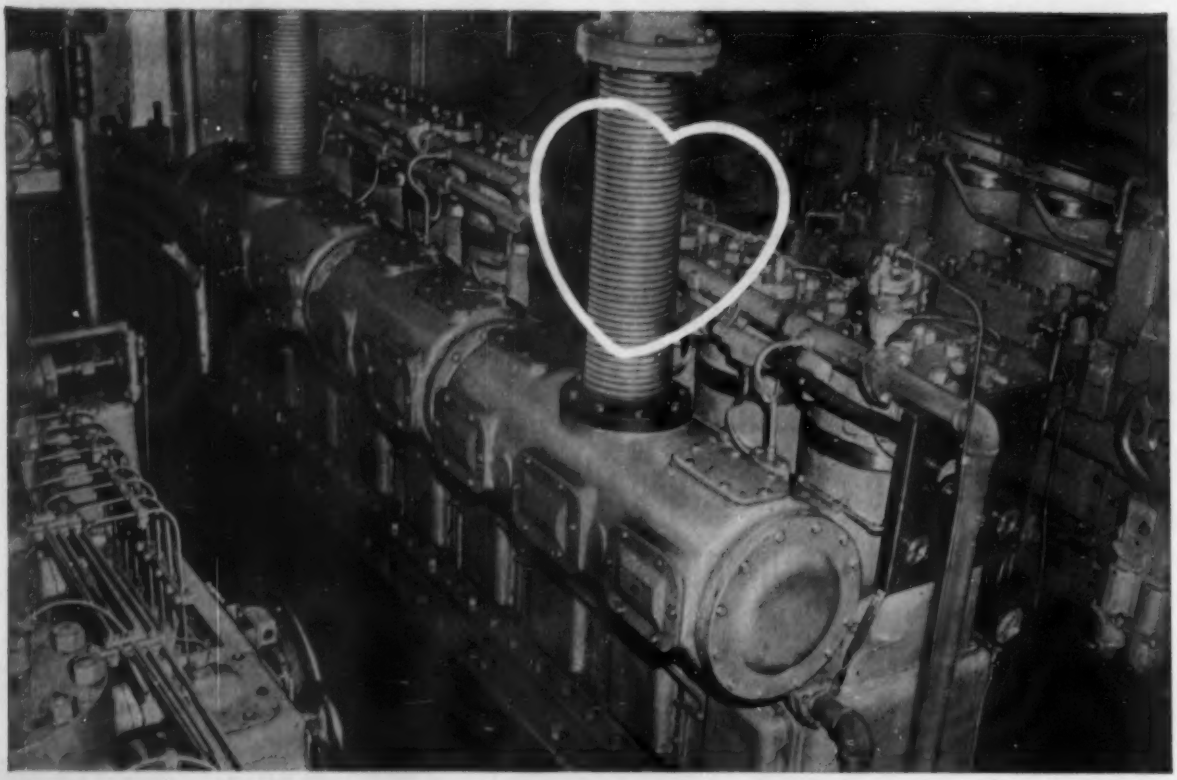
SIZES: 1½" through 6". **PRESSURES:** Up to 250 psi. **TEMPERATURES:** Up to 450° F. All sizes except 6" available with oversize inlet flanges.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



GIVES HORSEPOWER THE *P-U-R-R* OF A KITTEN

Flexible tubing reduces Diesel vibrations... Absorbs thermal expansion

Ever been around while a smoothly-running Diesel warmed up . . . and then, in a few minutes, began a series of vibrations? It's a condition often traced to the type of piping used on air intake and exhaust lines.

Such vibrations can be prevented . . . or cured . . . with Penflex four-wall interlocked tubing, which is flexible enough to absorb the vibration . . . tight enough to prevent any leakage of air and gases. It has other important features, too . . . it "gives"—instead of breaking with thermal expansion.

Afloat or ashore, Penflex tubing finds many applications on Diesel engines . . . on exhausts and air intakes . . . fuel oil and starting air lines . . . lubricating oil and water circulating lines . . . as a partial listing.

Penflex makes a complete line of four-wall, interlocking and seamless welded corrugated tubing, including braided-wire or rubber covered types . . . ⅛" to 24" I.D., in materials suited to various conditions.

"Flexineering," the science of selecting the tubing of the right size, weight, type and construction for these numerous applications, will be explained to you by Penflex engineers. Or you will find our "Flexineering" booklet both helpful and interesting. Send for your copy today.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7237 Powers Lane, Philadelphia 42, Penna. • *Branch Sales Offices:* Boston New York • Chicago • Houston • Cleveland and Distributors in Principal Cities

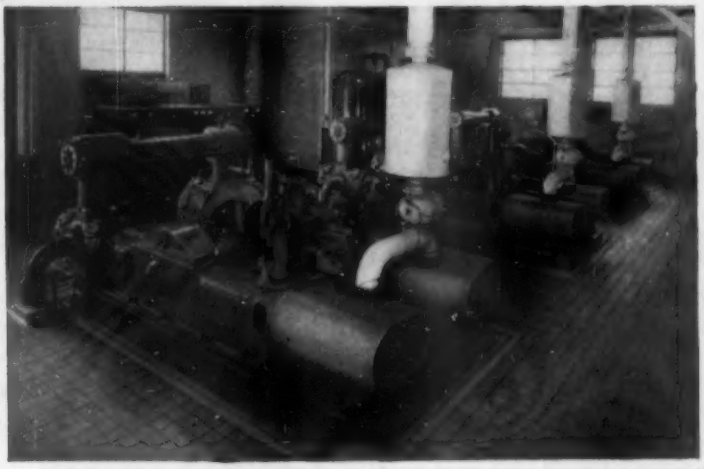
flexineering by

PENFLEX

HEART OF INDUSTRY'S LIFELINES

FLEXIBLE TUBING, AUTOMATIC BARREL FILLERS, PNEUMATIC RIVET PASSERS, ACCESSORIES AND FITTINGS

DON'T LET OFF STEAM!



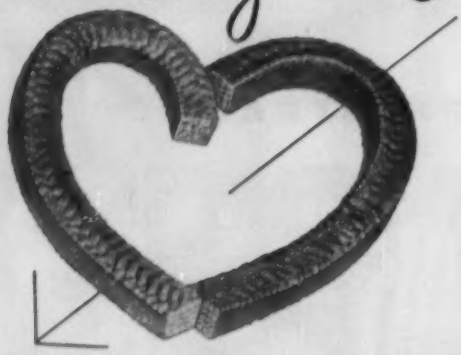
Put it to work with a Class H Compressor

If you can use exhaust steam economically, you can reduce compressed air costs with a dependable CP horizontal duplex Class H steam-driven Compressor. Equipped with steam cylinders properly proportioned to your steam conditions . . . throttling type governor or automatic cut-off for peak economy over a wide range of load . . . and Simplate valves, the Class H affords high economy in pounds of steam consumed per unit of air delivered. Capacities range from 900 to 7,400 cfm. (100-125 lb. air, 200 to 1,250 hp.) Other types and sizes available for lower or higher pressures. For details write *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

A honey of a packing with a strong heart!



NEW Palmetto "INTERWOVEN" SELF-LUBRICATING PACKINGS

For the highest speed centrifugal pumps—or any other application where pliability and high wear resistance is required . . . PALMETTO'S latest packing development has all this plus those features that have made PALMETTO the leader in the quality packing field.

As in all PALMETTO Self-Lubricating Packings, each strand is saturated separately *before* braiding, thus assuring complete and uniform lubrication of the *whole* packing. A reservoir of lubricant is "braided in" to make perfect sealing and long service life a certainty.

INTERWOVEN FOR EXTRA STRENGTH

In conventional packing each strand is braided only with the other strands in its own jacket . . . The *extra* in Palmetto Interwoven is a special braiding process which passes each strand through the heart of the packing. Consider the strength and wear resistance this adds to the packing! With each strand locked in, abrasion from moving parts will not weaken the packing by wearing away its surface. Since each strand passes through the packing, and not just along its surface, the finished product is highly pliable—not straight-jacketed.

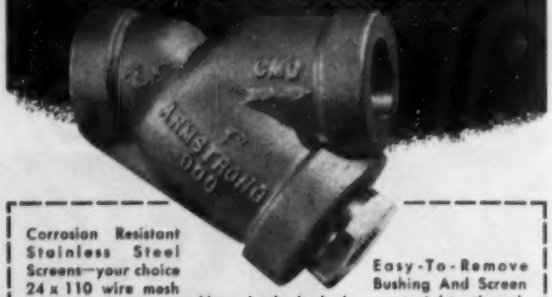
PALMETTO Packings

Bulletin IP-10 gives complete details . . . Write for it today!

packing more performance into every application

GREENE, TWEED & CO.
NORTH WALES, PA.

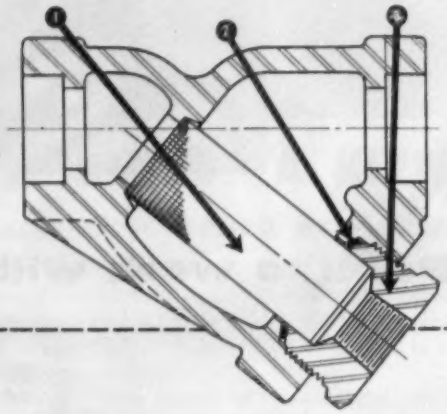
ARMSTRONG
MOLY STEEL
HI-TEMPERATURE • HI-PRESSURE
Y-TYPE STRAINERS



Corrosion Resistant Stainless Steel Screens—your choice 24 x 110 wire mesh or perforated with .045" dia. holes, 225 per square inch. (Special screens available at a slight extra charge).

Never-Leak, Locked-In Stainless-Asbestos Gasket—cannot blow-out...provides a positive seal against high pressures, high temperatures.

Easy-To-Remove Bushing And Screen — straight threads require only a light tension on bushing for a positive leak tight seal. Blow down or screen replacement is simple and easy.



Armstrong steel strainers are available in the ½" through 2" sizes. Connections are screwed or socket weld.

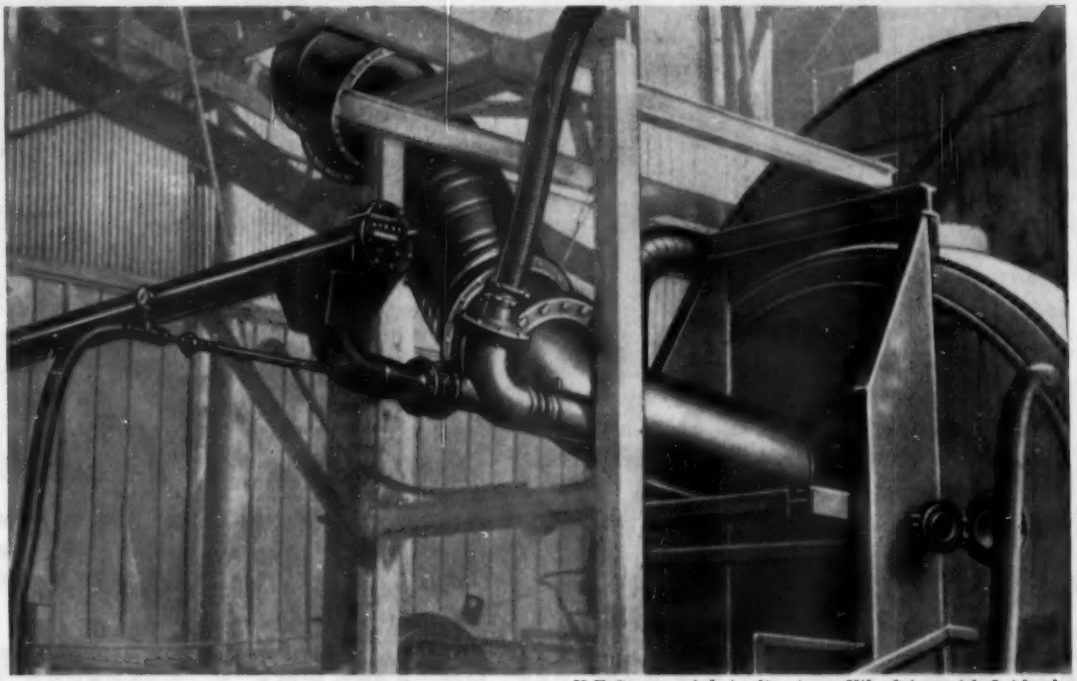
Armstrong Y-type pipe strainers for steam, air, oil, water, etc., are low cost insurance for the protection of valuable equipment — controllers, automatic valves, instruments, steam traps, etc. The new design features above guarantee easiest maintenance and longer service. Fast delivery from local stocks of screens, bodies, bushings and gaskets is another plus value.

Armstrong also offers a complete line of cast semi-steel strainers to 250 psi in sizes from ¼" to 2" (screwed connections only).

For complete price and size information see your local Armstrong Representative or write: Armstrong Machine Works, 812 Maple St., Three Rivers, Michigan.

ARMSTRONG
Y-TYPE PIPE STRAINERS

FLUID COKE...
Good News for Power People



K-E Commercial Application—Kiln firing with fluid coke.

DEVELOPMENT of the fluid coking process by America's petroleum industry is good news for the power industry.

This new refinery process produces more fluid coke than it uses — and the surplus is important to other industries. It is particularly important as a fuel for the power field, because it is clean, economical, and easy to handle.

Kaiser Engineers, authorized by Esso Research and Engineering to build fluid coking units, is also prepared to design and construct complete handling and burning equipment for this new high-potential fuel.

WRITE OR CALL our Power Division for a preliminary discussion and analysis — without obligation — to determine the economic feasibility of using fluid coke as a primary or supplementary fuel in your power plant operation.

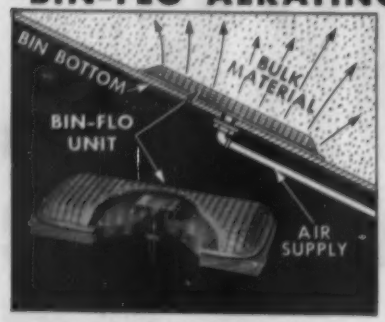
kaiser | engineers ...*for low operating costs*

DIVISION OF | HENRY J. KAISER COMPANY

ENGINEERS K CONTRACTORS

• HOME OFFICE: KAISER BUILDING, OAKLAND 12, CALIFORNIA (CABLE: KAISENGS) NEW YORK, PITTSBURGH, WASHINGTON, D. C.
• HENRY J. KAISER CONSTRUCTION CO. • HENRY J. KAISER COMPANY (Canada) LTD. • KAISER ENGINEERS INTERNATIONAL, INC.

BIN-FLO AERATING UNIT

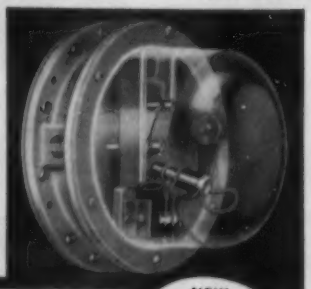


Provides Steady Flow of Dry, Finely Ground Materials which tend to bridge in storage. Uses only small amount low-pressure air.

BIN-DICATOR BIN LEVEL INDICATOR

For All Bulk Materials

signals change in level; automatically starts and stops filling and emptying equipment.



THE BIN-DICATOR CO.
13946-C2 Kercheval • Detroit 15, Mich.

NEW DETAIL DATA BOOK FREE

Solve your toughest HI-TEMP THREAD Problems with C-5

SEND FOR TEST SAMPLE **FREE**

No More SEIZING or GALLING of STUDS, Even at 1800°F

- ✓ Prevents stud breakage
- ✓ Eliminates pitting of Stainless Steel
- ✓ Reduces Torque
- ✓ Speeds up Disassembly

NOW, being used for boiler, manhole, handhole and face plate studs, turbine header studs, flange bolts on high temperature valves, steam lines, pumps, etc. 844PRR

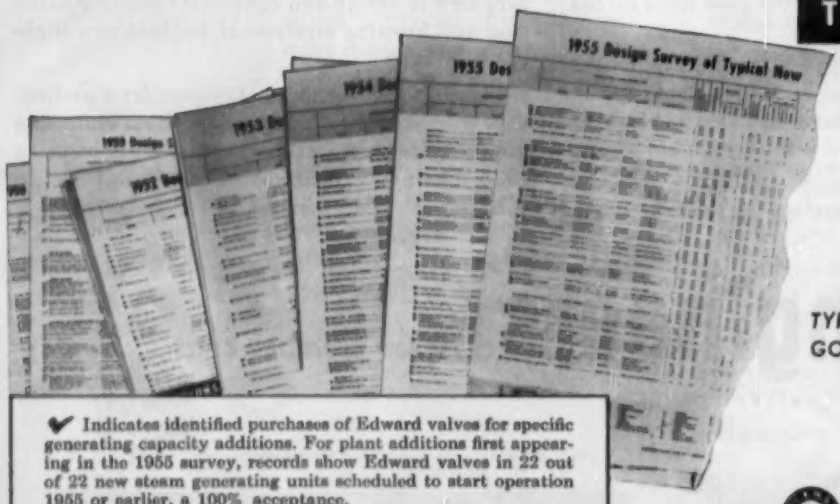
C-5 FEL-PRO "HI-TEMP" ANTI-SEIZE THREAD COMPOUND

Fel-Pro's exclusive C-5 colloidal-copper formula "copper-plates" metal . . . gives maximum cushioning and protection up to 1800°F without breakdown. Prevents galvanic action —eliminates pitting even where dissimilar metals are joined. Protects all threaded surfaces of bolts, plugs and studs, insuring their repeated re-use.

SEND FOR FREE SAMPLE TODAY on your company letterhead.

FELT PRODUCTS MFG. CO.
1539 Carroll Ave., Chicago 7, Ill.

Again in 1955 it's EDWARD VALVES in over 96% of new power plants!



✔ Indicates identified purchases of Edward valves for specific generating capacity additions. For plant additions first appearing in the 1955 survey, records show Edward valves in 22 out of 22 new steam generating units scheduled to start operation 1955 or earlier, a 100% acceptance.

(Note: Many of the projects listed in the 1955 survey are scheduled for 1956, 1957, 1958, etc., and the valves have not been purchased to date.)

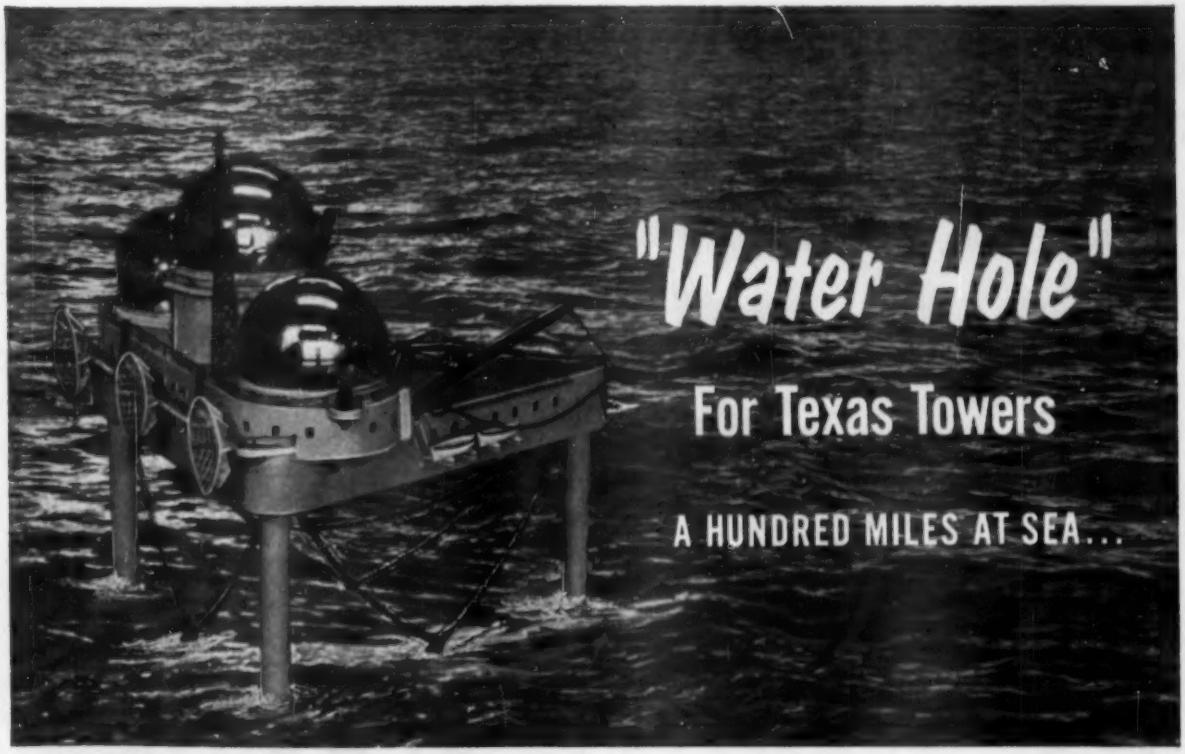
THE EVIDENCE:

752 out of 779 (96.53%) of new central station and municipal power plant generating capacity additions scheduled to start operation from 1948 through 1955 use EDWARD steel valves. (Source—1948, 1949, 1950, 1952, 1953, 1954 and 1955 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)

TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS

Cast Steel Non-Return—Cast Steel Stop—Cast Steel Gate—Cast Steel Check—Forged Stop—Forged Gage—Blow-off—Forged Instrument—Forged Univalves.

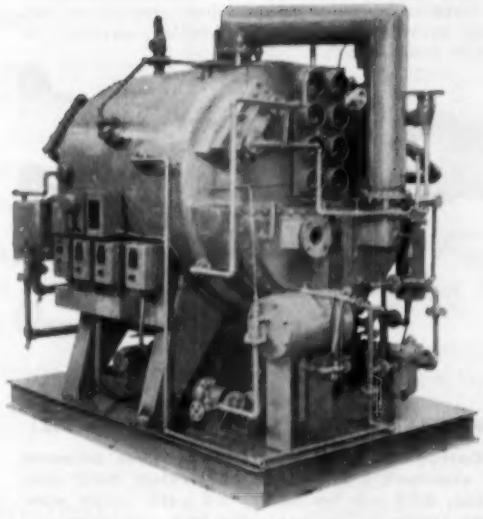
Edward Valves, Inc.
Subsidiary of ROCKWELL MFG. CO.
1230 W. 145th, EAST CHICAGO, INDIANA



Early-warning radar stations, standing far out in the open ocean, need plenty of fresh water—for drinking as well as other purposes. And to supply it, they depend largely upon sea water evaporators using Bridgeport condenser tubes.

In these installations Bridgeport 90-10 Cupro Nickel Tube was chosen because of its excellent service in evaporators handling sea water. Its resistance to general impingement corrosion at high velocities often offers unique advantages over other alloys in many applications.

This is but one of many effective applications of a particular Bridgeport Condenser Tube Alloy —carefully selected to give optimum performance on a specific job. Bridgeport's Technical Service will be glad to help you select from a wide range of Bridgeport alloys the one tube best suited to your particular operating conditions. Call your nearest Bridgeport Sales Office for complete information.



Pure, fresh drinking water for "Texas Towers" is distilled from the sea by a Cleaver-Brooks Sea Water Evaporator equipped with Bridgeport Cupro Nickel Condenser Tubes.

BRIDGEPORT BRASS

Offices in Principal Cities • Conveniently Located Warehouses

Bridgeport Brass Company, Bridgeport 2, Connecticut

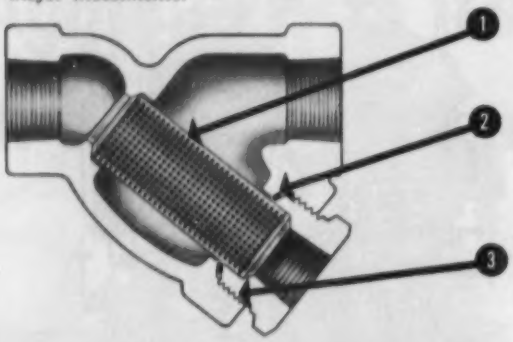
In Canada: Noranda Copper and Brass Limited, Montreal

BRASS Bridgeport CO.

"TINY INSURANCE FOR A MAJOR INVESTMENT"

Steam Traps	$10 to $400
Float Valves	$25 to $700
Solenoid Valves	$50 to $800
Pressure Regulators	$50 to $1,000
Etc. . . .	Etc. . . .

Armstrong cast semi-steel Y-type pipe strainers for pressures to 250 lbs. list between $2.75 and $10.00 — installed ahead of traps, valves, regulators, etc., they provide *tiny but dependable insurance for major investments.*



ARMSTRONG STRAINERS HAVE:

1. Corrosion-resistant stainless steel screens as standard — choice of perforated .045" dia. holes, 226 per sq. in. or 24 x 110 mesh wire cloth (screens available for any requirement).

2. Stainless-asbestos gasket is locked in — cannot blow-out.

3. Bushing and screen are easy to remove.

Armstrong Y-type pipe strainers are also available in cast carbon moly steel for up to 900 lb. pressure, 900°F service.

See your local Armstrong Representative or write for details.

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

ARMSTRONG Y-TYPE PIPE STRAINERS

Write For POWER'S "Reprint Folder"

Giving summaries and prices on Power's famous

SPECIAL REPORTS

the best condensed handbooks in the field

11/55

POWER, 330 West 42 St.,
New York 36, N. Y.

Gentlemen: Please send me a copy of Power's "Reprint Folder"

Name .....

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Address .....

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City & State .....

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EAGLE-PICHER

SUPER "66"

INSULATING CEMENT

➡ *STICKS* to hot or cold surfaces ⬅

BECAUSE IT STICKS, *it saves time*! Eagle-Picher Super "66" *really sticks,* makes difficult jobs easy, usually requires no reinforcing on applications up to 1½ inches thick. It applies quickly to any equipment, cold or heated up to 1800 F.

BECAUSE IT STICKS, *it saves money*! Low-cost Super "66" provides far greater coverage and more effective insulation. Its "springy ball" structure of small, resilient pellets of mineral wool, with thousands of dead air cells, assures maximum fuel savings!

BECAUSE IT STICKS, Eagle-Picher Super "66" can be used on irregular shapes where application of other insulations is often impossible.

PREVENTS RUST, TOO! Super "66" contains a special rust inhibitive that actually prevents corrosion.

WRITE FOR FREE SAMPLE TODAY!

Prove to yourself how easy it is to apply Super "66" wherever insulation is needed!

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

Producing a complete line of industrial insulations

Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

(Conforms to Commercial Standard CS117)

WHERE TO BUY

Featuring additional products, specialties & services for power plants

HILL PUMP VALVES

Since 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

FOR SALE: 4 ACF Parlor Coaches with Model 135 Hall-Scott engines; good running condition; clean. Two extra motors & lots of parts. Reasonable.

JAMES COLLEY, Owner
OSAGE BUS LINES
OSAGE CITY, KANSAS

STEEL PIPE & TUBING
● CHROME MOLY ● CARBON MOLY
● MONEL ● CARBON STEEL ● STAINLESS
● HASTELLOY
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

Master **GLASSES**

HIGH PRESSURE GASKETS

All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog — LIVINGSTON, N. J.

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers—The readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

●

Classified Advertising
POWER

PROFESSIONAL SERVICES

BLACK & VEATCH

Consulting Engineers

Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates

1706 Broadway — Kansas City 12, Missouri

BURNS & McDONNELL

Consulting and Designing Engineers

Kansas City, Mo. — Phone
P. O. Box 7088 — Delmar 4375

GILBERT ASSOCIATES, INC.

Engineers and Consultants

Design and Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing

New York — Reading, Pa. — Washington

INTERNATIONAL ENGINEERING COMPANY, INC.

Engineers

Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign

74 New Montgomery St., San Francisco 5, Calif.

THE KULJIAN CORPORATION

Engineers - Constructors - Consultants

POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical

1200 N. Broad St. — Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION

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Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural

First National Bank Building
Pittsburgh 22, Pennsylvania

THE LUMMUS COMPANY

Engineers and Constructors

385 Madison Ave., New York, N. Y.

Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

LUTZ AND MAY COMPANY

Consulting Engineers

Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals

1660 Baltimore — Kansas City 6, Mo.

MORGAN AND ASSOCIATES

Power and Utility Cost Consultants

Specialists in Cost Reduction Studies, Surveys, Analysis and Reports.
Electricity • Steam • Coal • Oil • Gas
Water • Air

1929 S. Taylor Rd. — Cleveland 18, Ohio

PIONEER SERVICE & ENGINEERING CO.

Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations

231 So. La Salle St. — Chicago 4

SANDERSON & PORTER

Construction

REPORTS — SURVEYS

New York — New York

SARGENT & LUNDY

Engineers

140 South Dearborn St. — Chicago, Illinois

SEELYE STEVENSON VALUE & KNECHT

Consulting Engineers

Mechanical — Electrical — Civil
Surveys Reports Design

101 Park Avenue — New York 17, N. Y.

J. E. SIRRINE COMPANY

Engineers

Power Plant — Consultations
Design — Reports
Water — Steam Utilization — Plants
Greenville — South Carolina

STANLEY ENGINEERING COMPANY

Consulting Engineers

227 S. LaSalle Street — Hershey Building
Chicago 4, Illinois — Muscatine, Iowa

A. L. SWANSON AND COMPANY

Consulting Engineers

Power Plants
Sawmills—Industrial Plant Layout
Heating—Ventilating—Plumbing
Reports, Designs, Drawings, Specifications

2210 West 12th Avenue — Vancouver 9, B. C.

WATER SERVICE LABORATORIES, INC.

Water Treatment for corrosion control in buildings, boilers and air conditioning systems—Chemical Laboratory Services—Consultation.

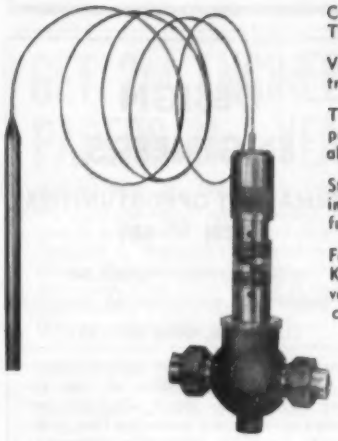
New York—Philadelphia—Washington, D. C.

THE J. G. WHITE ENGINEERING CORPORATION

Design-Construction-Reports-Appraisals

80 Broad Street, New York 4

CUT STEAM WASTE 2 WAYS with Klipfel THERMOSTATIC VALVES



KLIPFEL NO. 1449
TEMPERATURE CONTROL VALVE

Control that's accurate plus positive tight closing make Klipfel Thermostatic Valves real steam savers in operation.

Vapor pressure operated, these tank thermostats give control that's dependably sure . . . always.

Two types of single seated inner valves—both successfully proved on Klipfel's pressure reducing valves—are available for permanent tight closing.

Stainless steel ball inner valve and seat bushing with integral guides stops steam leakage, prevents wasteful, damaging overheating.

For high pressure applications and in larger sizes Klipfel's pilot balanced, cup disc type inner valve gives the same advantage of dead end closing.

For complete details, write Dept. D-11 for Bulletin 354.

Float Valves, Reducing Valves, Tank Thermostats, Back Pressure Valves.

Klipfel
Valves
Div. of Hamilton-Thomas Corp.
Hamilton, Ohio

Export Dept., 1010 Schaff Bldg.
Philadelphia, Pa.

TO KEEP LIQUIDS on-the-level

Klipfel FLOAT VALVES

- For liquid level control that's really automatic, depend on Klipfel Float Valves. They have a forty year record of dependability on thousands of installations, large and small, water and chemical, throughout the land.
- Available in direct acting or pilot control types, either single seated or double seated. Whatever your requirements of pressure, temperature, fluid and closure, there is a Klipfel Float Valve for the job.
- Also available with Klipfel's exclusive cup disc inner valve for tight control of liquids injurious to rubber and leather, and for higher pressures.

• For complete details, write Dept. D-11 for Bulletin 254. Float Valves, Reducing Valves, Tank Thermostats, Back Pressure Valves.

Klipfel VALVES, INC.
Division of Hamilton-Thomas Corp., Hamilton, Ohio
Export Dept., 1010 Schaff Bldg.
Philadelphia, Pa.

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
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Labor Bureaus

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The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on a column—3 columns—60 inches to a page.
Subject to Agency Commission.

$1.65 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to POWER, 330 W. 42nd St., N. Y. for December issue closing November 11th

A CAREER OPPORTUNITY

with

DU PONT

for an experienced

POWER ENGINEER

A unique career opportunity is now available to a graduate mechanical engineer (BS or MS) in our Engineering Department. The applicant must have 8 to 10 years of practical power experience, including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable.

The successful applicant will assist in specification of power equipment and in selection of new facilities, and will make economic evaluations and involved heat balances for complicated power systems.

Duties will include determination of causes of equipment malfunctioning and development of recommendations for corrections.

Please send complete resume including details of education and experience to:

Mr. J. C. Costello, Jr.
Personnel Relations Section
Engineering Department
E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

WANTED

Mechanical Engineer, experienced in Power operations for modern, expanding chemical manufacture in Ohio Valley, West Virginia panhandle. Two to three years experience preferred.

P-7843, POWER
330 W. 42nd Street
New York 36, N. Y.

IMPORTANT TEACHING POSITIONS OPEN IN ISRAEL

Technion, Israel Institute of Technology, Haifa, Israel, proposes to appoint:

Professor Structural Engineering
Professor of Hydraulic Engineering
Professor of Mechanical Engineering
Professor of Mechanical Engineering with special qualifications in Applied Thermodynamics
Professor of Mathematics

Applicants should have first-rate professional and academic qualifications, be willing to integrate themselves into the life of the country and, in due course, to teach in Hebrew.

Applications with full details should be sent in duplicate, for transmission to Haifa, to the:

AMERICAN TECHNION SOCIETY
1000 Fifth Ave., New York 28, N. Y.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Want to live in sunny Tucson? Results engineer, assistant, or man in similar capacity, familiar with all phases of power plant operation, for technical studies and sales engineering with large established manufacturer of water treating equipment. Work in famous health and recreation area; ideal dry Southwestern climate. Write care Box P-7762, Power.

Position Vacant Power plant superintendent for a municipal steam electric generation plant. Present average load 3200 KW. Plant in good condition. Must understand full operation and be able to direct personnel. Apply to Carl W. Fuehrer, Borough Manager Ephrata, Pa. giving qualifications, salary expected, availability for interview and date position could be accepted.

EMPLOYMENT SERVICE

Salaried Personnel. $5,000-$30,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, P.O. Box 674, Manchester, Vermont.

POSITIONS WANTED

Maintenance Engineer age 44, married, experienced in operations and maintenance high pressure steam power plants presently employed above position in 30,000 KW plant overseas go anywhere family can go. PW-7716, Power.

Power Engineer age 33, Marine Engineering school graduate, seven years Marine chief engineer, presently employed, one year, engineer in charge and responsible for the operation, maintenance and repair of a 400,000 KW high pressure steam plant, two units. Thoroughly understand all phases of power plant operation, maintenance and repair. Will accept position as power plant superintendent or equivalent with minimum salary $10,000. PW-8036, Power.

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PERMANENT OPPORTUNITIES WITH McKEE

IN OUR REFINERY, METALS OR INDUSTRIAL DIVISIONS AT OUR CLEVELAND, OHIO OFFICES

McKee with more than 50 years of successful operation, doing business all over the world; is one of the largest, oldest and best known engineering and contracting firms in the business. The McKee organization continues to grow and expand, thereby offers many present and future opportunities for qualified and experienced engineers and designers in the following fields:

PIPING • STRUCTURAL STEEL
CONCRETE • PROCESS HEATERS
EQUIPMENT SPECS.
ALSO
Electrical Drafts • Layout Engineers
Process Engineers

Applicants should have at least five years' of experience.

Here is a rare opportunity for you to utilize your engineering abilities and talents.

McKee offers top compensation commensurate with experience and ability. No age limitations.

Transportation & Moving Allowances.

Please Send Resume to: EDWARD A. KOLNER

ARTHUR G. McKEE & CO.
2300 Chester Ave., Cleveland 1, Ohio

MECHANICAL ENGINEER

Graduate mechanical engineer interested in power plant design work. Experience not required.
Excellent opportunity with consulting engineering firm in Middle West. Liberal benefit plans and good work conditions.
Send resume of education and experience with statement of salary requirements to:
P-8001, POWER
520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITY WANTED

Sales Agency desires to add established mechanical equipment lines. Present following in power plants, industrials, and utilities in the Michigan and Toledo, Ohio area. Address RA-7869, Power.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $1.65 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y. for December issue closing November 11th

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers • or Complete Power plants.

PAUL OBERMAN

1910 Delmar St. Louis, Mo.

FOR SALE

Operating diesel plant—Fairbanks Morse type 32E, 300 RPM, two cycle, 3 phase, 4 wire, 60 cycle, 220/440 volt.

Consisting of one: one 2 cylinder with 121 KVA generator and one 3 cylinder with 312 KVA generator. Woodward governor, synchronizer, pumps, oil purifiers, power panels, exciters, exhaust silencers, fuel tank and cooling radiators.

All very well maintained and in excellent condition. Low current and maintenance cost outfit. Can be inspected running. Good for many years full use or indefinitely as standby.

FS-7865, POWER
330 W. 42nd St., New York 36, N.Y.

FOR SALE

Mercury Arc Rectifier Substation Equipment

750-1000-1500-3000 KW
60 cycle — 3 phase

Write for details

FS-7833, POWER
330 W. 42nd St., New York 36, N. Y.

CHECK WITH WAGNER FIRST

"Certified Rebuilt" Motors and Generators

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	250	1000
200	Allis Ch. b.b.	EW	250	650
150	Whse.	SK-201	230	300/900
150	Whse.	SK-184	230	850
100	Whse.	SK-173	230	850
100	Reliance	651T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	Cr. Wh. TEFC	53H	230	850
75	F. Morse b.b.	DH-140	115	1600
60/75	Reliance b.b.	651-T	230	500/1500
50	Whse.	SK-113	230	1750
50	Gen. Elec.	BF-14	230	500/1200
50	G.E. dynam. (4)	TLC25	250	1000/3500
50	Whse. (2)	SK-143	230	850
40	Whse. (3)	SK-133	230	850
35	Whse.	SK-163	230	300/900
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	L. A. TEFC	RNA	230	850

MOTOR-GENERATOR SETS

KW	Mfr.	Input V.	Output V.
500	Whse.*	2200 AC	250 DC
300	G.E. rotary conv.	440 AC	250 DC
300	Allis Ch.	2300/440 AC	125/250 DC
250	Allis Ch.	2300.440 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	F. Morse b.b.	220/440 AC	125/250 DC
75	Cont. b.b.	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
40	Whse. (2)	220/440 AC	250 DC
30	Gen. Elec. (2)	220/440 AC	125 DC
30	F. Morse b.b.	220/440 AC	24 DC
30	Allis Ch.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
20	Rel. b.b. (2)	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis Ch. b.b.	EW	250	1200
175	Allis Ch. b.b.	EW	250	900
150	Whse.	SK-184	250	1150
105	Century b.b.	1500 amp.	70	1200
100	Whse.	SK-173	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651T	600	1200
75	F.M. b.b.	DG	125/250	1200
75	Cont. b.b.	D100X	125	1150
75	F.M. b.b.	DG	125	1800
75	Cr. Wh. bb (2)	CCD	250	1150
50	Whse. (2)	SK-142	250	1150
40	Whse.	SK-133	250	1150
25	G.E. b.b. (10)	CD85	250	2200
25	Whse.	SK93	125	1750

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Synch.	2300	514
700	Allis Ch.	Sq. Cage	440	900
700	G.E.	Synch.	2300/440	1200
600	G.E.	Slipring	2300/440	600
600	G.E.	Synch.	2200	327
500	G.E.	Sq. Cage	2200	3600
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	400
400	G.E.	Slipring	2300	900
400	Whse.	Sq. Cage	2300	514
400	G.E.	Synch.	440	450
300	Whse.	Sq. Cage	440	400
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2300/440	720
300	Whse.	Synch.	2200/440	600
300	G.E.	Slipring	440	360
250	Whse. X-P	Sq. Cage	2300	3600
250	Burke	Synch.	220/440	360
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	230/440	900
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
300	Whse. (2)	Slipring	2300/440	720
200	Gen. Elec.	Sq. Cage	230/440	1200
300	Reliance b.b.	Sq. Cage	220/440	1800
300	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2300/440	720
300	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2300/440	900
200	E. M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	G.E.	Slipring	2300	450
150	Allis Ch.	Slipring	2300/440	720
150	G.E. (2)	Sq. Cage	2300/440	720
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	G.E. vertical	Slipring	4000/2300	1200
125	G.E.	Slipring	220/440	720
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Whse.	Sq. Cage	220/440	900
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G.E.	Slipring	220/440	450
125	Allis Ch.	Slipring	220/440	900
100	G.E.	Slipring	220/440	720
100	Rel. TEFC	Sq. Cage	220/440	1200
100	G.E.	Slipring	220/440	514

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
750	Gen. Elec.	ATI	2300/480	1200
625	Gen. Elec.	ATB	2300	450
435	Allis Ch.	1 brg.	480	400
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
156	Whse.	C	240/480	1200
150	Whse.		2300/480	600
75	El. Machy.		2300	900
56	G.E.	ATB	240/480	1200
37½	Whse.		240/480	1200

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LARGE ELEC. POWER EQUIPMENT

SELECTED STOCK ITEMS

RE-NU-BUILT—GUARANTEED—RE-NU-BILT

COMBINATION MILL DRIVES — 15/2500 HP

D.C. MOTORS WITH M.G. SETS & CONTROLS

	MAKE	TYPE	VOLTS	R.P.M.
2200 HP	G.E.	MCF-12	600	600/500
2000 KW	G.E.	Syn.	2300/4600	514
1400 HP	G.E.	MCF14	600	63/190
1500 KW	G.E.	Syn.	6600/13200	720
1250 HP	Whse.	Rev.	600	300/600
1600 KW	G.E.	Syn.	2300/4600	720
1250 HP	G.E.	MCF	600	750/900
1000 KW	G.E.	Syn.	2300/4600	720
1000 HP	G.E.	MCF-8	600	250/750
1000 KW	G.E.	Syn.	2300/4150	720
350 HP	Whse.	Mill	250	250/950
300 KW	Whse.	Syn.	220/440	1200
200 HP	G.E.	CD-1650Z	250	500/1500
200 KW	Whse.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	225
1	750	G.E.	MT	575	2300/1150
1	700	Al. Ch.	D.P.	2300	360
1	500	Whse.	CW	550	350
1	500	G.E.	M-569Z	2300	1180
1	450	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2300	435
3	300	G.E.	IM-17A	440	2300/720

SQUIRREL CAGE

1	800	G.E.	KT-573	2300	1180
1	650	G.E.	PT-556BY	440	3570
1	500	G.E.	K-6345B	2300	1185
1	450	Whse.	CS-1420	2300/4150	854
1	400	G.E.	1E-15B	2300	1165
1	400	G.E.	IK	2300	500
1	300	G.E.	IK-17	440	580
5	300	G.E.	KT-507	440	1800

SYNCHRONOUS

1	4250	C.W.	3501-8L	13800/4000	514
1	1750	G.E.	ATI	2300	3600
1	2000	Whse.		2300	120
1	750	G.E.	ATI	2300/12000	600
1	500	Ideal	SM	2300/4150	1800
1	500	G.E.	TS-7507	2300	1200
1	450	Whse.		2300	450
1	400	G.E.	TS	2300	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2600	G.E.	450	250/300	2300/4600
1	2000	G.E.	600 25cy	600	11000
6	2000	G.E.	514	600	6600/13200
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	C.W.	514	30/115	4000/13000
1	1000	G.E.	720	600	2300/4600
1	1000	G.E.	900	230	6600
1	750	Whse.	900	230	2300/6150
1	750	C.W.	514	30/115	2300
1	750	G.E.	900	125/250	2300
1	600	G.E.	720	250	440/2300
1	500	Whse.	900	250	2300/6150
1	500	Whse.	1200	250	440/2300
1	350	A.C.	900	125	2300/4600
1	300	Whse.	1200	250	220/440
1	100	Whse.	1200	600	2300

SIX 1200 KW RECTIFIERS

Whse., D.C output, 2000 Amp., 283/600 volts, with 1338 KVA, 3 ph., 60 cy., Transf., 11,000 volts and controls. Can furnish for other voltages.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Wagner	HPW-30	3	26400x2400
2	4300	G.E.-Pur.	POWT	3	13800x200/87

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	12500/12200
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	2540	13000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4400	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4600 V Direct conn exciter.
1	1500	Whse.	Auto. extraction 196 lbs.—600# F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/30# G. Ext. Surface Condenser—3/60/2300.
1	1000	G.E.	Non-condensing 175/200 lbs. I.S.P. 5/30 lbs. G.B.P., 480/3/60.
1	750	G.E.	Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

There's more than 40% to 60% SAVINGS

SCHOONMAKER DEPENDABLE

DIESEL POWER

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Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

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So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
675	Fairbanks Morse	38D	960	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	Fairbanks Morse	32E14	450	300
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
148	Fairbanks Morse	32E14	225	300
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

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6—100 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

6—75 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

9—37½ KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

19—15 KVA 60 cy. 1 ph. Dry Type 240/480-120/240

15—25 KVA 60 cy 1 ph. Dry Type 240/480—120/240

8—37½ KVA 60 cy. 1 ph. Dry Type 240/480—120/240.

3—50 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.

3—10 KVA 60 cy 3 ph. Dry Type 480—208Y/120.

2—37½ KVA 60 cy 3 ph Dry Type 480—208Y/120.

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3—Kewanee Firebox Boilers, 304 HP, 125 PSI WP, Series 500, Model 590. ASME & Natl. Board stamped. New 1942.

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1—250 HP, B. & W. Stirling, 150 PSI, ASME, comb. gas & oil burners.

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Westinghouse turbine, Max. press. throttle 340# P.S.I.G., Bleeder Station 110# P.S.I.G., Exh. 30# P.S.I.G Satu. Steam. Ser. Nos.—12750 & 12751.

W.H. AC gens., 1563 K.V.A., 480 volts, 1880 amps., 60 cyc., 3600 R.P.M., type SO-2G135, 80% P.F., 3 ph., Ser. No.—4953392-93.

W.H. DC exc., type SK, 16 K.W., 125 volts, 128 amps., 3600 R.P.M., frame 43, sty. No. 2G136.

Still on hnds. In exc. condition. Price and further inf. on request.

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Price BRAND NEW ONLY ..... $23.95 Ea.

#8-9527-WE. — WESTINGHOUSE. — Same Specs. But Single 115 V Input & Lighter Wt. NEW $23.95

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IMMEDIATELY AVAILABLE

4000 KW Westinghouse, Condensing, 400# psig, 750 Deg. FTT, 3/60/2400 V.
2500 KW General Electric, Non-condensing, 150# psig, 10/25# B.P., 2300 V.
2500 KW General Electric, Condensing, 200/250# psig, 3/60/2300/4160 V.
2500 KW General Electric Generator only, 3/60/6600 V.
2500 KW General Electric Turbine only, Condensing, 175/250# psig, 100 Deg. FTT
2000 KW Westinghouse, 250# psig (good for 400# with changes) Non-condensing 10/50# B.P., 2300 V. Like new.
2000 KW Westinghouse, Condensing, 250/400#, 750 Deg. F., 3/60/2400 V.
1500 KW General Electric, Extraction 50#, Condensing 200#, 100 Deg., 2300 V.
1500 KW Allis-Chalmers Non-condensing, 140# psig, 20# B.P., 3/60/480 V.
1500 KW General Electric, Condensing, 415# psig, 100 Deg. FSH, 3/60/2300 V. Complete unit—condition good.
1250 KW Allis-Chalmers, Non-condensing, 130# psig, 15# B.P., 480 V.
1000 KW Allis-Chalmers, Non-condensing, 150/200# psig, 480 V.
1000 KW Allis-Chalmers, Non-condensing, 130# psig, 15# B.P., 480 V.
1000 KW General Electric, Non-condensing, 400# psig, 50# B.P., 3/60/2300 V. Used very little.
500 KW General Electric, Non-condensing, 175# psig, 500 Deg. FTT, 3/60/2300 V.
500 KW Westinghouse, Non-condensing, 225/250# psig, (good for 400#) 150 Deg. FSH, 2400 V., 125# B.P.
500 KW General Electric, Non-condensing, 150/200# psig, 3/60/480 V.
500 KW General Electric, 125/150# psig, Non-condensing, 12/15# B.P., 480 V.
375 KW Murray & Gear, Non-condensing, 225/250# psig, 10# B.P., 488/1200 RPM
300 KW General Electric DC, Condensing, 250 V. Little used.
300 KW General Electric, D.C. Generator only, 250 V., 1200 RPM
125 KW General Electric, D.C. Generator only, 250 V., 1200 RPM
500 KW Westinghouse Non-condensing, 150#, 12# B.P., 3/60/480 V.
500 KW Westinghouse, Non-condensing, 150#, 10# B.P., 3/60/2300/4160 V.

DIESEL ENGINES, BOILERS, ETC.

8—268-A, 200 KW General Motors Diesel Engine Generator Set, complete.
700 KW Baldwin Diesel Generator Set, 327 RPM, 3/60/2300 V. New in 1942. Condition: excellent.
BOILERS: 2—100,000# steam per hour, Marine-type, new, never erected, complete units: immediate delivery.
4—Wickes 500 HP, 250# psig, 100 Deg. F., good condition
Also several others: send us your Specifications for anything wanted not mentioned here.

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DETROIT 35, MICHIGAN
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3 G. M. 200 KW DIESEL GENERATOR SETS

Reconditioned by U.S. Navy

EQUAL TO NEW

Complete with motor driven starting air compressors, air tanks, dead front type generator switch panels and all other necessary accessories.

ENGINES

G.M. Model 8-268A—6½x7—1200 RPM—air starting—complete with engine operating panels, heat exchangers, cooling pumps, filters, strainers, governors, pyrometers, etc.

GENERATORS

Westinghouse 200 KW 250 KVA—440/3/60—1200 RPM—80% P.F.—continuous—drip-proof enclosure—direct connected exciter.

SIZE AND WEIGHT

Each unit, mounted on a pre-fab sub-base, is 13' 9 5/16" long, 3' 10½" wide, approx. 8' high. Weight of engine and generator only, 17,705 lbs. Each unit, with all accessories, about 27,000 lbs.

CONDITION

No expense has been spared to put these 3 units in "equal to new" condition. Don't miss this opportunity to buy! Inspection can be made at our warehouse, Curtis Bay, Baltimore.

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313 E. BALTIMORE STREET
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Rebuilt HEMPHILL *Guaranteed* EQUIPMENT

TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
1	1000	Amer.	Pyranol	3	4150x480
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600x120/240
2	400	Pitts.	OISC	1	4150x240/480
3	75	G.E.	Pyranol	1	2400/4160-240/480
3	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	Pyranol	1	2400/4160-120/240
3	200	G.E.	H	1	7860/15600-440/220
3	150	Amer.	OISC	1	2400/4160-240/480

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1400	G.E.	514	ATI	4150
1	1600	Whse.	225	MIII	2300/4150
1	1000	West.	360	MIII	2300/4150
1	500	Whse.	450	HH	2300
1	300	EM	720	TEFC	2300
1	300	G.E.	600	ATI	220/440/2400
1	200	Whse.	600	ATI	240
3	150	G.E.	1200	TS	4150
1	150	G.E.	1800	TS	220
2	150	Allis	360		2200
1	125	EM	900		4800
1	100	G.E.	900	TS	2200

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	450
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
3	150	A.C.	1800	AY RW	220
1	100	G.E.	1800	IM	220
1	100	G.E.	600	MT	440
1	75	G.E.	600	IM	44
1	60	G.E.	1800	MT	220
1	200	Whse.	500	CW	440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 3yn
1	1000	Whse.	720	600	2300/4150 3yn
1	1000	Whse.	720	275	2300/4150 3yn
1	300	G.E.	1200	250	2300/4150 3B
1	200	Whse.	900	250	2300/4150 3yn
1	150	C.W.	600	125	220/440 3
1	100	G.E.	900	250	2300 3yn
1	97	G.E.	1200	60	4150 3yn
1	75	G.E.	1800	250	220/440 3C
1	60	Whse.	1200	60	2300V
3	60	EM	1200	125	220
1	30	Whse.SK	1750	250	2300/4150 3yn
1	20	EM	1800	125	220 V
1	7½	Allis	1800	125	220/440
2	5	G.E.	1800	125	220/440
2	3	G.E.	1800	250	220/440
2	30	G.E.	1800	1735	220/440 V

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
3	30	C.W.	700	CM
1	25	G.E.	850	RC
1	25	Whse.	850	RC
3	30	G.E.	1650/1800	CDM85

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3—683 CFM—XLE COMPRESSORS
3 INGERSOLL RAND 125 HP, 220/440 V. NEW 1953, WITH AFTERCOOLER.
90 HP CYCLOTHERM STEAM GENERATOR
1—125 LB. PRES. PACKAGE BOILER OIL FIRED. LOCATED OHIO.
45 TON WHIRLEY CRANE
1 CLYDE E20—110' BOOM ELEC. 2 YRS. OLD.
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7500 K.V.A., 22000 to 265 Volts. Late Type, Excellent Condition.
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40 HP 200 lbs. Pressure Erie City Boiler
35 HP (2) Leffel Scotch Marines
7½—5—3 Ton O.E.T. Cranes with motors
375 KVA Gen. dir. con. Corliss Engine
65,000 Gallon Stand Pipe Tank
100 & 150 KVA Moloney Transformers
800 KW Gas Engine—Generator Set
550 KW GE Rotary Converter—Complete
H. & P., 6719 Etzel, St. Louis 14, Mo.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	2300	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
300	2300/440	G. E.	720
300	440	G. E. (hoist)	514
300	2300	G. E.	300
300	440	Whse.	3600
250	440/220	Whse.	600
200	550/440	G. E.	1200
200	6600/2300	G.E. (hoist)	600
200	440/220	Whse.	514
150 (2)	440/220	G. E.	720
150	2300/440	G. E.	600
135	440/220	G. E.	900
125	550/440	G. E.	1200
125	2300	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Mschy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2300/440	G. E.	TS	1200
250	2300/440	G. E.	TS	720
200	440/220	Whse.	HB	277
200	440/220	G. E.	ATI	600
125	440/220	Whse.	HB	600

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2300	G. E.	PT	3600
500	2300/4000	Elliot	SC	1800
500	2300	G. E.		450
400	2300/4000	Whse.	CS	720
400	2300/4000	G.E.	S	1800
300	440	G.E.	KT	1200
300	2300/4000	L. Allis	FS	1800
250	2300	G.E.	S	900
225 (3)	2300/440	G. E.	KT	1200
200	440/220	G. E.	KT	1800
200	2300/440	G. E.	JK	600
200	2300	G. E.	KT	1800
150	2300	Al. Chal.	AH	1800
150	220	Whse.	CS	1200
150	440/220	G. E.	KT	720
150	2300/440		KT	600

A. C. GENERATORS

1—320 kva, 600 rpm 2300/440/230 V., G. E.
1—300 kva, 900 rpm, 480/220 V., G.E.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2300/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKH-155-23, 600 amp., 15,000 V., G.E.
1—400 Amp., Cendit, 3P, 25 KV outdoor
1—600 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	Whse.	SK	1750
90	230	G. E.	CD	1750

MOTOR GENERATOR SETS

KW	Make	Input V.. A.C.	Motor Type	Output V.. D.C.
250	Whse.	2200	Syn.	250
200	G.E.	440/220	Syn.	250
175	G. E.	220/440	Syn.	230
125	G.E.	4000/440	Syn.	125
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
65	G. E.	2300/440	sq. ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—500 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V
2—333 kva, G.E., 25000/11500—2300 V.
3—333 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mol., 13,800—2300 V.
2—200 kva, G. E., 2300—575 V
2—100 kva, Al. Ch., 2400—480/240 V.

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625 ADAMS ST., HOBOKEN 2, N. J.

DIESEL POWER UNITS

two 300 HP, 327 RPM, installed new 1947; one 100 HP diesel power unit, 327 RPM, all with or without generator sets.

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1—3½" x 10" Worthington Hydraulic, Type D1654, 85 GPM, 500 PSI, #978859

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3—150 KVA, Maloney, OISC, 4000 volt primary, 230/460 volt secondary, 1 phase, 60 cycle
3—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle
6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle

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400	Al-Ch.	2300	120/240
400	G.E.	2300	270
300	G.E.	2300	230
200	G.E.	2300	230/275
200	Westg.	4160/2250	275
200	Ridgeway	2300	230
170	G.E.	440	125
150	Al-Ch.	2300	275

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HP	MAKE	*230 Volt TYPE	SPD.
250	Westg.	SK-220	450/600
200	Westg.	SK-201	650
200	Cr-Wh.	CM	500
175	G.E.	FLC	750
100	G.E.	MPC	400/800
100	G.E.	BC-34	2500
100	G.E.	BC-19	575
75/75	Westg.	SK-151	400/1600
50/120	G.E.	MCF	250/1000
50	Cr-Wh.	CMC	700/1100

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3 phase 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
1250	*Al-Ch.	ANW	3600
1250	*Al-Ch.	ANW	1200
800	*Westg.	CS	3600
800	*Westg.	CS-1485	1800
700	*Westg.	CS	1200
700	Al-Ch.	AN	900
500	*Al-Ch.	6316-SW	1800
500	G.E.	RT-424	450
400	G.E.	RT-424	360
350	Ideal	A	1800
300	*G.E.	K-6344Y	1200
300	G.E.	K-6353 TEFC	720
250	G.E.	RT-5998	1800
250	*L-Allis	OGK-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
2000	*G.E.	MT	600
1500	*G.E.	MT-20	240
1250	Westg.	CW	600
1000	*Westg.	CW	450
700	*Al-Ch.	ANY	720
500	Westg.	CW	350
400	Al-Ch.	3 brg.	450
400	G.E.	IE-17	720
300	*G.E.	IE-15A	1200
250	Westg.	HP-15H	600
250	*G.E.	I-17B	450
200	G.E.	IK-15B	900
200	G.E	IM-17	600

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2000/1000	6/12	Chandy	220
1500/750	12/24	Chandy	220
1500/750	6/12	Chandy	220
1000/500	12/24	Chandy	220
250	12	Hanson & VW	220/440
220	6	Holtzer-C	220

SPEED REDUCERS

HP	MAKE	MAX SPEED	TYPE & RATIO
250	W.A. Jones	1200	210 SH; 5.63:1
150	W.A. Jones	1200	180 SH; 5.63:1
30	Falk	1750	3028E; 9.394:1

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HP	MAKE	TYPE	PF	SPD
1420	*West.		.7	900
800	G.E.	TS-EL	1.	1200
700	G.E.	TS-EL	.8	1200
600	*G.E.	TS-7640	1.	900
500	*G.E.	TS-7657	1.	514
400	*West.	H	.8	1800
400	West.	HG	1.	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
300	G.E.	ATI	.8	900
250	G.E.	ATI	.8	900

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150-H.P.—125 Lb. Cyclotherm #6—Oil
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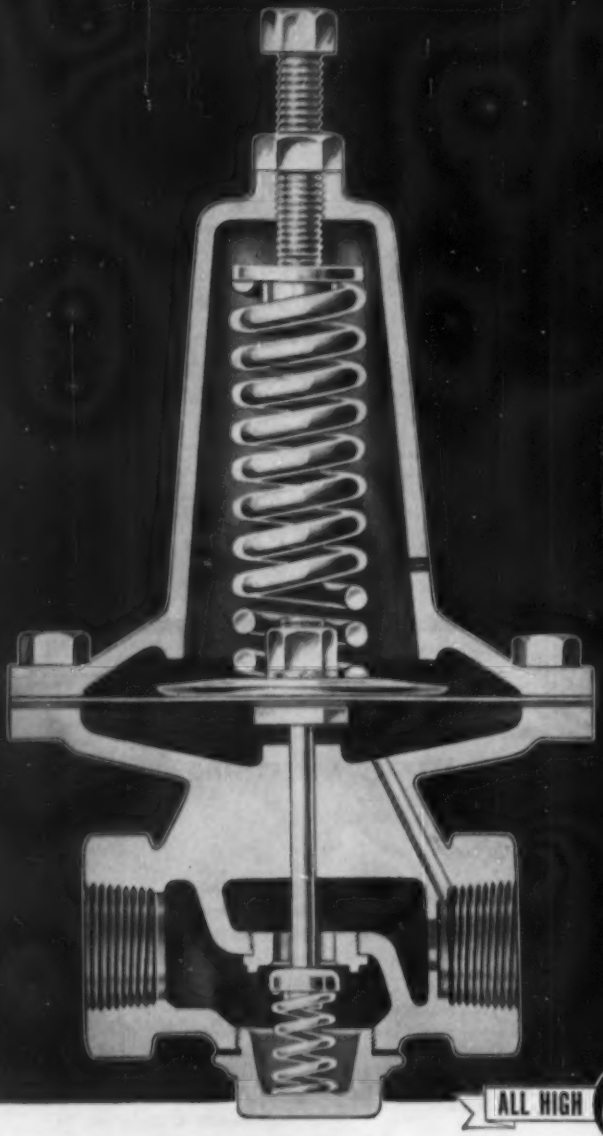
FOR SMALL

STEAM LINES



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No. 11 for steam

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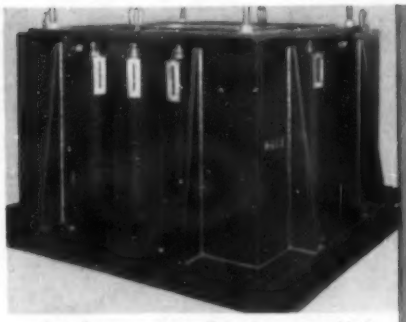
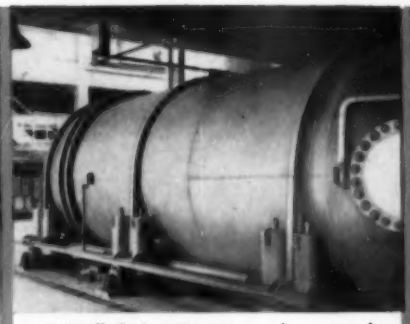
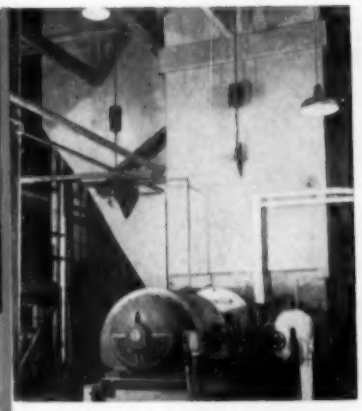


Base for supporting refinery tower, provided with Grinnell Spring Hangers for flexible support.



Grinnell Spring Hangers on large vessel of catalytic cracking unit in oil refinery.



Induced draft duct and blower in power station. Operates at about 500°F. Supported by Grinnell Spring Hangers.

To support loads that won't stand still . . .

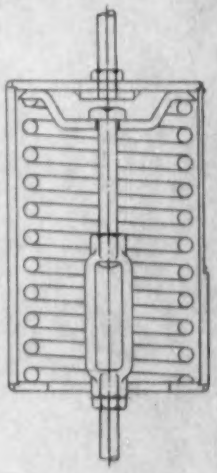
GRINNELL PRE-ENGINEERED SPRING HANGERS

There are many industrial installations where heavy loads must be firmly, but flexibly, supported to keep them under control. Thermal expansion and contraction, of course, can move ponderous objects many inches. Shock and vibration, too, can make rigid support of heavy loads hazardous, due to possible serious trouble at terminals.

For installations such as these, more and more engineers are turning to *flexible* supports by Grinnell. Grinnell Variable Spring Hangers are *pre-engineered* to minimize changes in supporting force over total range of movement. Here are the important features that let these units turn in a star performance in a supporting role:

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- Solid steel casing protects spring from damage and weather. Guides assure continuous alignment and concentric loading of spring.
- 18 sizes available from stock — load ranges from 53 lbs. to 12,000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.

*Precompression is a patented feature.



VARIABLE SPRING HANGER FIG. B-268

Fig. B-268, Type A, is designed for attachment to its supporting member by screwing a rod into a bushing in the top cap of the hanger. Adjustment of the hanger load is accomplished by turning the turnbuckle on the lower hanger rod until the hanger picks up the load and the load indicator points to the desired position. Six other types of attachment are available.

Grinnell Variable Spring Hangers are also available in half sizes (Fig. B-82); and in double spring sizes (Fig. B-98).

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

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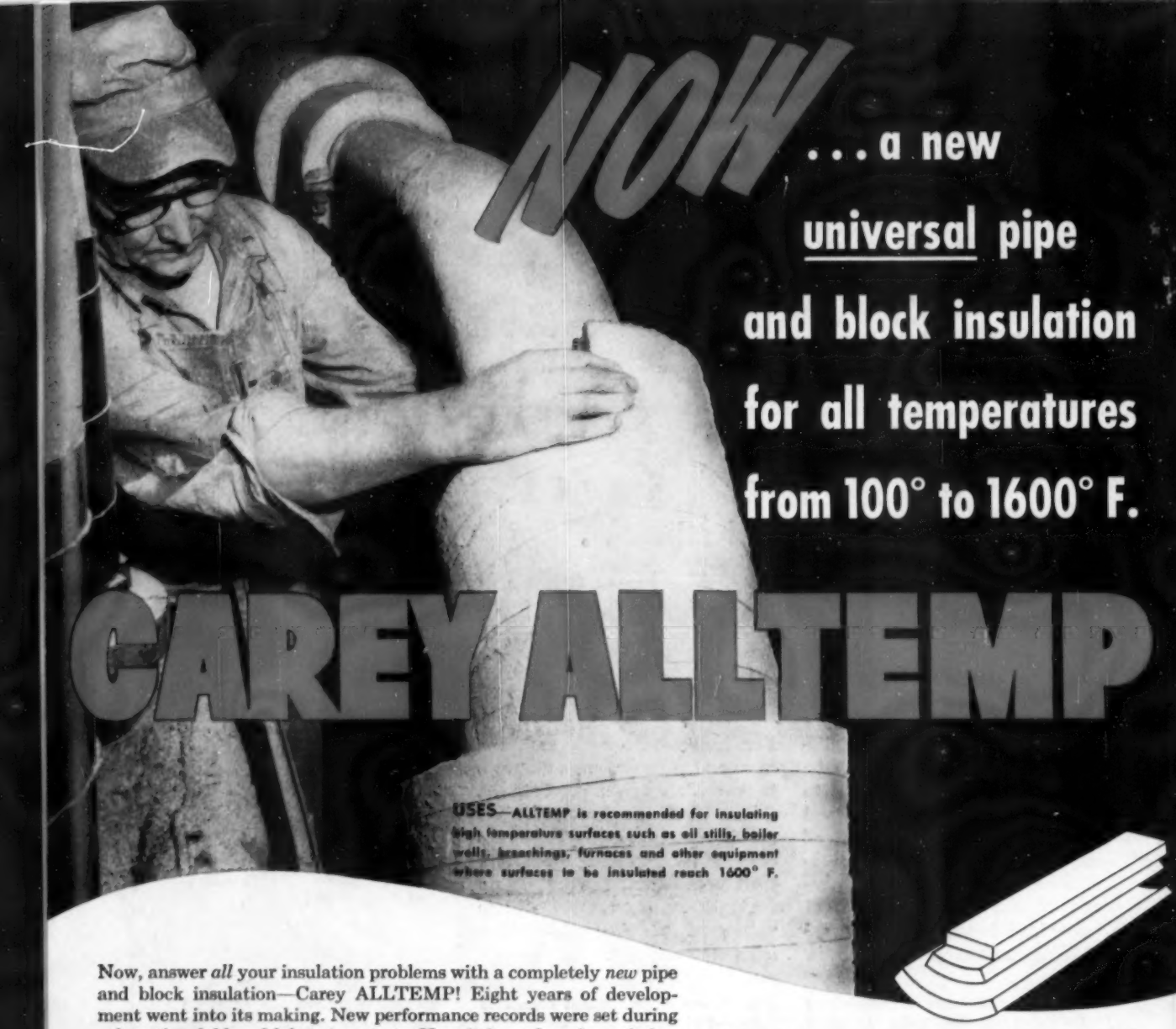

NOW . . . a new universal pipe and block insulation for all temperatures from 100° to 1600° F.

CAREY ALLTEMP

USES—ALLTEMP is recommended for insulating high temperature surfaces such as oil stills, boiler walls, breechings, furnaces and other equipment where surfaces to be insulated reach 1600° F.

Now, answer *all* your insulation problems with a completely *new* pipe and block insulation—Carey ALLTEMP! Eight years of development went into its making. New performance records were set during exhaustive field and laboratory tests. Here it is—*a brand-new industrial insulation* for all temperatures up to 1600° F.

ALLTEMP keeps every last BTU on the job producing power. Its extremely low percentage of shrinkage—approximately ⅔ *less* than other 1200° F. insulation materials—means joints won't open, cracks won't appear in covering. BTU's are *locked in!* ALLTEMP retains its high thermal efficiency and structural strength even after long, continuous exposure to excessive heat and moisture. Non-brittle, it resists blows, abrasions; won't crack or crumble under severe service conditions. And it's easy on the hands—easy to cut, fit, install!

Get all the cost-saving facts on new ALLTEMP today and your copy of the Carey ALLTEMP specification folder.
Just address coupon below.

ALLTEMP RECOMMENDED THICKNESS

Nominal Pipe Size Inches	Temperature Difference °F 80° Air					
	200	400	600	800	1000	1200
	Nominal Thickness, Inches					
1½ & Under	1	1	1½	2	2½	3
2	1	1½	2	2½	2½	3
2½	1	1½	2	2½	3	3½
3	1	1½	2	3	3	3½
3½	1	1½	2	3	3½	3½
4	1	1½	2½	3	3½	4
4½	1½	2	2½	3	3½	4
5	1½	2	2½	3	3½	4
6	1½	2	2½	3½	4	4½
7	1½	2	2½	3½	4	4½
8	1½	2	3	3½	4	4½
9	1½	2	3	3½	4½	5
10	1½	2½	3	4	4½	5
11	1½	2½	3	4	4½	5
12	1½	2½	3	4	4½	5
14 & Over	1½	2½	3½	4	4½	5½

ALLTEMP is available in clean, easy-to-handle flat and preformed blocks. "Nesting" O.D. pipe covering sizes provide accurate, tight fits for multiple layer construction. Only a limited number of "prime" units are necessary for unusual assemblies.

Better Products for Industry Since 1873

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THE PHILIP CAREY MFG. COMPANY
Lockland, Cincinnati 15, Ohio
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Carey-approved contract units in major trading areas. Consult your nearest Carey District Office or your Telephone directory.

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Please send free illustrated folder showing specifications, installation details and complete facts on new ALLTEMP insulation.

☐ Have your Industrial Sales Engineer call without obligation.

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